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A Revision of the Genus *Cincticostella* (Insecta: Ephemeroptera: Ephemerellidae) from Japan

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The Japanese mayfly genus *Cincticostella* is taxonomically revised. The four currently recognized species are *Cincticostella* (*Cincticostella*) *elongatula* (McLachlan, 1875) (=*okumai* Gose, 1980, syn. nov.), *C.* (*C.*) *levanidovae* (Tshernova, 1952), *C.* (*C.*) *nigra* (Uéno, 1928), and *C.* (*C.*) *orientalis* (Tshernova, 1952) (=*tshernovae* (Bajkova, 1962). The lectotype and paralectotypes of *Ephemerella nigra* are designated from the syntypes of Uéno. Specimens treated as *C.* (*C.*) *nigra* by many authors are identified with *C.* (*C.*) *elongatula*. All species are redescribed based on examined types and newly collected specimens. Keys are given to all stages: imagoes, subimagoes, nymphs, and eggs. Illustrations, complete synonymies, and distributional records are included for all the species, and the life histories of two species, *C.* (*C.*) *elongatula* and *C.* (*C.*) *nigra*, are presented.
Key Words: *Cincticostella*, Ephemerellidae, Ephemeroptera, taxonomic revision, synonymy, Japan.

Introduction

The genus *Cincticostella*, belonging to the subfamily Ephemerellinae, was originally described as a subgenus of *Ephemerella* by Allen (1971), who later elevated it to generic rank (Allen 1980). The genus is known from eastern and southeastern Asia and is currently grouped into two subgenera, *Cincticostella s. str.* and *Rhionella* Allen (Allen 1984).

Revising the mayflies of Manchuria, Inner Mongolia, and Korea, Imanishi (1940) presented a nymphal key to 31 nominal species and 36 newly named taxa under his concept. Each of the latter was proposed with binominal formation (ex. *Ephemerella nay*, *Ephemerella nG*, *Ephemerella nM*, etc.), but he also stated that the names were only for temporary reference and not for formal taxomic use. These names are, therefore, unavailable under the provision of Art. 8.3. of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999).

In an introductory article on the Japanese mayflies, Gose (1980a) described two new species, *Ephemerella* (*Cincticostella*) *ezoensis*, Gose, 1980 and *E.* (*C.*) *okumai*, Gose, 1980, and presented a key including five other species under this genus: *E.* (*C.*) *atagosana* Imanishi, 1937, *E.* (*C.*) *castanea* Allen, 1971, *E.* (*C.*) *nigra* Uéno, 1928, *E.* (*C.*) *orientalis* Tshernova, 1952, and *E.* (*C.*) *tshernovae* Bajkova, 1962. However, Gose's new species described after 1978 were not cited in a checklist of the

Japanese Ephemeroptera (Tadauchi 1989); instead, an argument was presented for the nomenclatural unavailability of these names. Makibayashi (1998) stated Gose's species to be nomina nuda because of the lack of any indication that the taxa were new and the lack of type designations. Establishing his new species, Gose (1980a) provided a diagnostic key to distinguish the two new species from other species; therefore, their names are available under the provision of Art. 13.1.1. of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999).

Ishiwata (1987) reviewed the generic characters of Japanese Ephemerellidae on the basis of Allen's (1980) concept and pointed out the taxonomic confusion. Tshernova *et al.* (1986) transferred *Cincticostella atagosana* to *Ephemerella*. Ishiwata (1993) listed all the nominal species of Japanese Ephemerellidae including the six valid species of *Cincticostella* at that time. Bae (1997) historically reviewed the mayflies of northeast Asia and also enumerated six valid species in this genus. *Cincticostella castanea* was synonymized with *C. levanidovae* (Tshernova, 1952) by Bae *et al.* (1998), and *E.* (*C.*) *ezoensis* with *Ephemerella aurivillii* Bengtsson, 1908 by Ishiwata (2001a). Accordingly, in Japan, Korea, and the Russian Far East, four species still remain in the genus *Cincticostella*.

The purposes of the present paper are: 1) to describe the external morphology of the imagoes, subimagoes, nymphs, and eggs of the genus *Cincticostella*; 2) to discuss the population density and individual variation in each species; and 3) to provide illustrations and keys to assist in identification. In addition, the life histories of the two closely related species *C.* (*C.*) *elongatula* (McLachlan, 1875) and *C.* (*C.*) *nigra* are presented.

Materials and Methods

Materials. Imagoes, subimagoes, nymphs, and eggs used in this study were preserved in 75% ethanol. Fully developed eggs were obtained from mature nymphs, subimagoes, or imagoes. The male genitalia were dehydrated in a series of ethanol, acetone, and isoamylacatate and dried by a critical point dryer (JEOL JCPD-5) for SEM investigations. The subsequent process of SEM micrography was done following Ishiwata (1996). Distribution maps include only verified localities in this study and in the following previous studies: Uchida (1986), Hatta and Ishiwata (1990), Ishiwata *et al.* (1991), Ishiwata (1997a, 1997b, 2000, 2002).

For the life history studies, a D-frame kick net with a fine (38 μm mesh) net was used at the collecting station in Houkisawa (550 m a.s.l.), a tributary of the Sakawa Riv., Yamakita, Kanagawa, central Japan. This stream was sampled 18 times from September, 1981, to June, 1982. The body lengths of collected specimens were measured to the nearest 0.5 mm.

Terminology. The terms for thoracic morphology used in this study follow Kluge (1994) for the most part.

Abbreviations. For synonym lists: des, description of species; ?, ?-mark in original text. For sexes and stages: M, male imago; F, female imago; MS, male subimago; FS, female subimago; N, nymph. For imaginal thorax: BS1, probasisternum; BS2, mesobasisternum; FS1, profurcasternum; FS2, mesofurcasternum; LPs, lateroparapsidal suture; MLs, median longitudinal suture; MNs, mesonotal suture; MPs, medioparapsidal suture. For collectors: HM, H. Mitsuhashi; KH, K. Hashimoto; KI, K. Imanishi; KS, K. Sakai; NK, N. Kobayashi; RK, R. Kuranishi; SI, S. Ishiwata; SS, S. Sasaki; SU, S. Uchida; TI, T. Ito; TN, T. Nozaki; YT, Y. Takemon. For collection depositories: BM, Entomology Department, The Natural History Museum, London, England; CAS, The California Academy of Sciences, San Francisco, USA; CERK, Center for Ecological Research, Kyoto University, Otsu, Japan; USL, University of Utah, Salt Lake City, USA; ZIS, Zoological Institute, St. Petersburg, Russia; RK, Kuranishi personal collection, National History Museum and Institute, Chiba, Japan; IC, Ito personal collection, Hokkaido Fish Hatchery, Hokkaido, Japan; no indication, author's collection, Kanagawa Environmental Research Center, Kanagawa, Japan.

Genus *Cincticostella* Allen
[Japanese name: Tôyô-madara-kagerou-zoku]

Ephemerella nigra-group: Imanishi 1938: 33.

Cincticostella Allen, 1971: 513 (as subgenus of *Ephemerella*) [type species: *Ephemerella nigra* Uéno, 1928, original designation].

Cincticostella: Tshernova 1972: 614 (footnote); Allen 1980: 82; 1984: 246; Ishiwata 1987: 29; Yoon and Bae 1988b: 28; Hubbard 1990: 37; McCafferty and Wang 2000: 39.

Asiatella Tshernova 1972: 611. [Unavailable, see Discussion below]

Diagnosis. *Cincticostella* can be distinguished from all other genera of Ephemerellidae by the following combination of characters. In the adults, 1) well developed posterior prolongation of scutellum present in all subimagoes (Figs 21–24) and in some imagoes (Figs 17, 19), 2) terminal segment of genital forceps less than twice as long as broad (Figs 2, 6, 10, 14), 3) second segment of genital forceps sharply bent at submedian constriction (Figs 2, 6, 10, 14), and 4) penis-lobes apically acute (Figs 2, 10, 14) or apically expanded (Fig. 6), without spine. In the nymphs, 1) head with or without tubercles, and without frontal projections, 2) maxillae with apical tuft of setae and cuticular tooth on medio-anterior edge of galea-lacinia (Figs 37, 38), without apical canines, and with maxillary palpi well developed, vestigial, or absent, 3) antero-lateral corners of prothorax produced anteriorly and mesothorax expanded laterally in anterior portion, 4) fore femora without tubercles along inner margin and with band of transverse spines or tubercles subapically (Figs 50a, 51a, 52a, 53a), 5) middle and hind femora flat and wide with spines or protuberances along outer margin (Figs 50b, 51b, 52b, 53b), and 6) abdominal terga with paired dorsal submedian tubercles and with lamellate, imbricated gills on terga 3–7. In the eggs, 1) polar cap present (Figs 3, 7, 11, 15) and 2) chorion covered with reticulate tubercles (or broken reticulations) with 1–5 tubercles in each reticulation (Figs 4, 8, 12, 16).

Discussion. Imanishi (1938) recognized two distinct species groups in the genus *Ephemerella*, the *nigra*-group and the *trispina*-group, and placed *Ephemerella nigra* and closely related species in the *nigra*-group. Allen (1971) established *Cincticostella* as a subgenus of *Ephemerella* for the *nigra*-group and gave diagnostic characters for the adult and nymphal stages. However, the imaginal di-

agnosis was only based on *E. nigra, sensu* Allen (1971) (namely *C. elongatula*, see Discussion below), because *E. nigra* was the only species known from both stages. Tshernova (1972) once established the genus *Asiatella* for the following species: *E. nigra*, *E. femorata* Tshernova, 1972, *E. orientalis* Tshernova, 1952, *E. levanidovae* Tshernova, 1952, and *E. tshernovae* Bajkova, 1962, but, after learning of Allen's (1971) *Cincticostella*, she synonymized *Asiatella* with *Cincticostella* in a footnote added in proof at the end of the same paper. Thus *Asiatella* is unavailable under the provision of Art. 11.6. of the International Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999). In Korea, a diagnosis using both stages was given by Yoon and Bae (1988b), but the imaginal diagnosis was based only on the male genitalia of *C. castanea* (=*C. levanidovae*). Ishiwata (1987) redescribed *Cincticostella* based on Allen's (1971, 1975) concept and listed the seven nominal species. However, a comprehensive revision of the adults have never been done.

Imanishi (1938) indicated the presence of a posterior prolongation of the scutellum as one of the morphological features of the *nigra*-group in the adult stage, but I have found that some species in other genera have the same feature. In addition, some individuals of the Japanese species of *Cincticostella* lack this character in the adult stage.

In establishing the subgenus *Cincticostella*, Allen (1971) included foreleg ratios among the diagnostic characters. I have found that these features are unreliable in the genus, particularly in the species *C.* (*C.*) *levanidovae* and *C.* (*C.*) *orientalis*. I have therefore modified the generic diagnosis.

In the nymphal stage, I agree with Tshernova (1972) that the presence of a cuticular tooth on the medio-anterior edge of the galea-lacinia and an apical tuft of setae on each maxilla are the key characters. No other genus in the family Ephemerellidae has these features except for *Ephacerella*, which can otherwise be distinguished from *Cincticostella* by mesonotum with a pair of trianglar processes near anterolateral coner and slender legs with numerous denticles on claws (Ishiwata 1987). These characters were also used by Kang and Yang (1995) as one of the diagnostic characters of *Cincticostella*.

Although Studemann *et al.* (1995) and Studemann and Landolt (1997) stated that most chorionic patterns cannot be used to solve generic problems in Ephemerellidae, I have found that the eggs of all the species of *Cincticostella* in Japan, Korea, and the Russian Far East possess a chorion covered with reticulations.

Subgenus ***Cincticostella*** Allen
[Japanese name: Tôyô-madara-kagerou-azoku]

Cincticostella: Allen 1980: 83 (as subgenus of *Cincticostella*); 1984: 246; Hubbard 1990: 38.

Diagnosis. Nymphs of the subgenus *Cincticostella* can be distinguished from those of the subgenus *Rhionella* by the following combination of characters: 1) head without occipital tubercles, 2) maxillary palpi either well developed or vestigial, 3) fore femora with band of transverse spines subapically (Figs 50a, 51a, 52a, 53a), and 4) middle and hind femora with spines or protuberances along outer margin (Figs 50b, 51b, 52b, 53b) (Allen 1980).

Discussion. Allen (1980) divided the genus *Cincticostella* into two subgenera with brief descriptions of each; second subgenus, *Rhionella*, was established on the basis of differences in nymphal stages. According to these criteria, all species described from Japan, Korea, and the Russian Far East can be assigned to the subgenus *Cincticostella*.

Key to Species of the Subgenus *Cincticostella*

Imago

1. Penes smoothly tapered apically, neither swollen nor expanded (Fig. 14); carinae on basisternum of prosternum strongly narrowed anteriorly (maximum width between lateral margins of carina more than 3 times minimum width in male and female) (Fig. 30); apex of sternum 9 rounded in female ..... *C.* (*C.*) *orientalis*
– Penes swollen or expanded, not smoothly tapered apically; carinae on basisternum of prosternum slightly narrowed anteriorly (maximum width between lateral margins of carina less than twice minimum width in male and female) (Figs 27–29); apex of sternum 9 truncate, often with shallow, rounded median emargination in female 2
2. Penes expanded (Fig. 6); head with paired occipital spots in female; abdominal terga with two pairs of dark stripes in male and female. Japan (Tsushima Is.), Korea, and Russian Far East ..... *C.* (*C.*) *levanidovae*
– Penes swollen (Figs 2, 10); head without paired occipital spots in female; abdominal terga without two pairs of dark stripes in male and female (rarely with two pairs of weak stripes). Japan (except Tsushima Is.) and Russian Far East (Kuril Is.) 3
3. Body relatively small (7.4–9.6 mm long), uniformly dark brown to black; primary longitudinal veins of forewings yellowish to hyaline apically ..... *C.* (*C.*) *nigra*
– Body relatively large (7.3–13.3 mm long), light brown to chocolate brown; primary longitudinal veins of forewings blackish-brown apically ..... *C.* (*C.*) *elongatula*

Subimago

1. Wings black (Figs 9, 13) 2
– Wings brown, with crossveins infuscated (Figs 1, 5) 3
2. Carinae on probasisternum narrowed anteriorly; caudal filaments less than half body length; apex of sternum 9 rounded in female ..... *C.* (*C.*) *orientalis*
– Carinae on probasisternum not narrowed anteriorly; caudal filaments greater than 2/3 body length; apex of sternum 9 truncate in female, often with shallow, rounded median emargination ..... *C.* (*C.*) *nigra*
3. Penes expanded apically; abdominal terga with two pairs of dark stripes; head with pair of occipital spots in female ..... *C.* (*C.*) *levanidovae*
– Penes not expanded apically; abdominal terga without two pairs of dark stripes (rarely with pair of dark stripes), head without pair of occipital spots in female ..... *C.* (*C.*) *elongatula*

Nymph

1. Caudal filaments less than half body length; labrum with deep anteromedian emargination (Fig. 32); maxillae widened apically (Fig. 42); tarsal claws with 1–2 denticles ..... *C.* (*C.*) *orientalis*
– Caudal filaments greater than 2/3 body length; labrum broad with shallow anteromedian emargination (Fig. 31); maxillae not as above; tarsal claws with 5–8 denticles 2
2. Dorsal surface of femora entirely covered with small depressed spots (Fig. 47) ..... *C.* (*C.*) *levanidovae*
– Dorsal surface of femora smooth or covered with short clavate setae, without small depressed spots 3
3. Dorsal surface of femora with short, dense clavate setae (Figs 46, 50) ..... *C.* (*C.*) *elongatula*
– Dorsal surface of femora smooth, without short clavate setae (Figs 48, 52) ..... *C.* (*C.*) *nigra*

Egg

1. Egg relatively small (length with polar cap 132–165 μm, width 102–110 μm); chorion covered with broken reticulations (Figs 7, 8) ..... *C.* (*C.*) *levanidovae*
– Egg relatively large (length with polar cap 162–182 μm, width 116–120 μm); chorion covered with reticulate tubercles 2
2. Each chorionic reticulation with more than three tubercles (Figs 15, 16) ..... *C.* (*C.*) *orientalis*
– Each chorionic reticulation with one tubercle (rarely two) (Figs 3, 4, 11, 12) ..... *C.* (*C.*) *elongatula* and *C.* (*C.*) *nigra*

Cincticostella* (*Cincticostella*) *elongatula (McLachlan, 1875), comb. nov.
[Japanese name: Ookuma-madara-kagerou]
(Figs 1–4, 17, 21, 27, 39, 46, 50a, b, 54a, 56)

Leptophlebia elongatula McLachlan, 1875: 169 [des. (F, FS)]. [Lectotype F, designated by Kimmins (1960); type locality, Yokohama, Japan; lectotype deposition, BM].

Ephemerella elongatula: Eaton 1884: 131 [des. (F)]; Ulmer 1929: 164 [des. (M, F), fig. (M)]; Edmunds 1959: 546; Kimmins 1960: 304; 1971: 313; Ishiwata 1987: 29; 2001a: 64.

Ephemerella nigra: Horasawa 1931: 31 [des. (F, FS), fig. (FS)]; Imanishi 1937: 325 [des. (M, F, FS), fig. (M)]; Uéno 1950: 128 [des. (M, F), fig. (M, F)]; Tshernova 1972: 612 (in part). [Not Uéno, 1928]

Ephemella [sic] *elongatula*: Ulmer 1935–1936: 213.

Ephemerella sp. (tentatively named "EC"): Gose 1962: 15 [fig. (N), key]; 1970: 15 [fig. (N), key].

Ephemerella (*Cincticostella*) *nigra*: Allen 1971: 513 [des. (M, N), fig. (M, N)]; 1975: 18 [key (N)]; Tshernova *et al.* 1986: 138 [fig. (M), key (M)]. [Not Uéno, 1928]

Ephemerella (*Cincticostella*) *okumai* Gose, 1980a: 288 [fig. (N), key (N)], described as new species based on Gose's "*Ephemerella* EC" [material, N (type information unknown)]; 1980b: 368 [fig. (M), key (N)]; 1985: 26 [fig. (N), key (N)]. **Syn. nov.**

Cincticostella okumai: Uchida 1986: 4; Ishiwata 1987: 29; Yamasaki 1987: 115 [fig. (N)]; Hatta and Ishiwata 1990: 167 [fig. (N)]; Ishiwata *et al.* 1991: 25; Tiunova 1995: 6; Ishiwata 1997a: 293; 1997b: 13; Bae 1997: 409; Ishiwata 2000: 74; 2001a: 60; 2001b: 175; 2002: 7 [fig. (MS, N)].

Description. *Male imago.* Length (N=33): Body 8.7–12.0 mm; fore wing 11.0–12.9 mm; hindwing 3.0–3.6 mm; caudal filaments 11.9–14.5 mm.

Head: Color chocolate brown; upper part of compound eye of live specimen light brown, lower part black.

Thorax: Pronotum chocolate brown to blackish brown, often with pale maculae. Basisternum of prosternum yellowish brown to blackish brown, with longitudinal carinae; carinae slightly converging anteriorly (maximum width between lateral margins of carina less than twice minimum width) (Fig. 27); furcasternum yellowish brown to blackish brown. Mesonotum (Fig. 17) chocolate brown to blackish brown; lateroparapsidal sutures (LPs) not terminating at MPs; scutellum with posterior prolongation and pair of membranous posterior lamellae. Mesosternum chocolate brown; basisternum narrowed anteriorly; furcasternal protuberances parallel. Fore wings hyaline; stigmatic area opaque; basal costal crossveins not developed; primary longitudinal veins yellowish brown basally, blackish brown apically; crossvein brown. Fore legs dark brown to black, often with pale maculae; fore tibiae about twice as long as fore femora; fore tarsi ranked 2, 3, 4, 5, and 1 in order of length; middle and hind legs yellowish brown; tarsi often dark brown.

Abdomen: Terga light brown to chocolate brown, usually with pale maculae, often with dorso-lateral stain longitudinally or often with 2 pairs of dark stripes, occasionally with pair of indistinct lateral stripes. Penes not expanded, pointed at apex and with subapical swelling (Fig. 2); second segment of genital forceps sharply angled inward and with subapical constriction; third segment less than twice as long as broad. Caudal filaments dark brown basally, pale apically, with brown annulation; terminal filament somewhat longer than cerci.

Female imago. Length (N=18): Body 7.3–13.3 mm; fore wing 12.2–14.5 mm; hindwing 2.6–4.0 mm; caudal filaments 11.2–13.9 mm.

Other features as in male imago except for usual sexual differences and following characters:

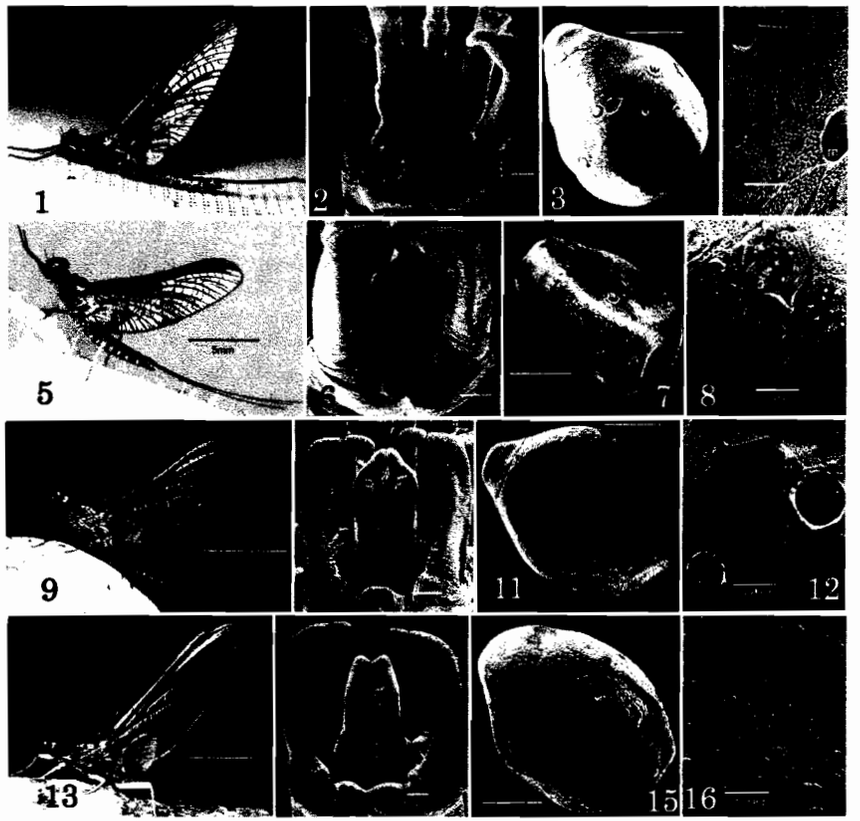
Thorax: Width of prosternal carinae somewhat greater than that of male. Mesobasisternum nearly quadrate; furcasternal protuberances wider than those of male. Fore tibiae relatively short, only about 1.2 times as long as fore femora.

Abdomen: Apex of sternum 9 truncate and often with shallowly rounded median emargination.

Male subimago. As in male imago except for duller general coloration and following characters:

Head: Upper part of compound eye of live specimen reddish brown, lower part black.

Thorax: Pronotum chocolate brown, with membranous tubercle posteriorly. Mesonotum (Fig. 21) with membranous tubercle at junction of mesonotal suture (MNs); pigmented areas reddish brown; pigmented sclerotization on medioparapsidal sutures (MPs) elongate (sclerotizated region 1/4–1/3 as long as MPs); scutellum with long posterior prolongation and pair of membranous posterior lamellae. Wings brown; vein dark; intercalary and crossvein infuscated (Fig. 1).



Figs 1–16. Adults, male genitalia, and eggs of *Cincticostella* (*Cincticostella*) spp. 1–4, *Cincticostella* (*C.*) *elongatula*: 1, male subimago (lateral view); 2, male genitalia (ventral); 3, egg; 4, chorion. 5–8, *C.* (*C.*) *levanidovae*: 5, male subimago (lateral); 6, male genitalia (ventral); 7, egg; 8, chorion. 9–12, *C.* (*C.*) *nigra*: 9, male subimago (lateral); 10, male genitalia (ventral); 11, egg; 12, chorion. 13–16, *C.* (*C.*) *orientalis*: 13, male subimago (lateral); 14, male genitalia (ventral); 15, egg; 16, chorion.

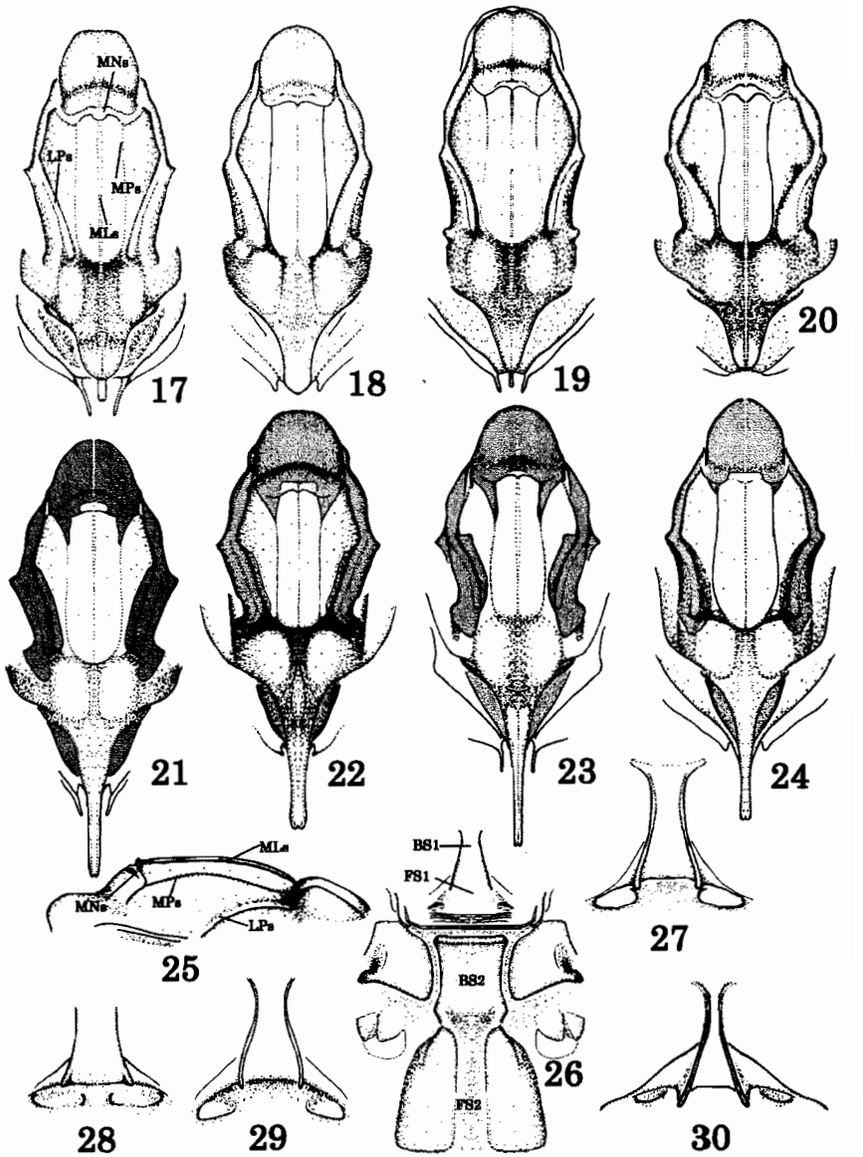
Abdomen: Abdominal terga often with maculae and pair of dark stripes. Caudal filaments subequal to or somewhat shorter than body length.

Female subimago. As in male subimago except for usual sexual differences and following characters:

Thorax: Width of prosternal carinae somewhat greater than in male. Width of mesobasisternum subequal to length; furcasternal protuberances wider than those of male.

Abdomen: Apex of sternum 9 truncate and often with shallowly rounded median emargination.

Mature nymph. Length (N=53): Body 9.0–12.2 mm; caudal filaments 7.3–9.8 mm.



Figs 17–30. Adult thoracic characters of *Cincticostella* (*Cincticostella*) spp. (17–24, dorsal views; 25, lateral view; 26–30, ventral views). 17–20, mesonota (imago): 17, *Cincticostella* (*C.*) *elongatula*; 18, *C.* (*C.*) *levanidovae*; 19, *C.* (*C.*) *nigra*; 20, *C.* (*C.*) *orientalis*. 21–24, mesonota (subimago): 21, *C.* (*C.*) *elongatula*; 22, *C.* (*C.*) *levanidovae*; 23, *C.* (*C.*) *nigra*; 24, *C.* (*C.*) *orientalis*. 25–26, *C.* (*C.*) *nigra* (imago): 25, mesonotum; 26, pro- and mesosterna. 27–30, prosterna (imago): 27, *C.* (*C.*) *elongatula*; 28, *C.* (*C.*) *levanidovae*; 29, *C.* (*C.*) *nigra*; 30, *C.* (*C.*) *orientalis*. For abbreviations see "Materials and Methods".

Coloration: Dark brown, often each with pale maculae on head, thorax, legs, and abdomen.

Head: Vertex without tubercles; genae rounded. Labrum (similar to Fig. 31) with broad, shallow anteromedian emargination. Mandibles (similar to Fig. 34) with narrow incisors on right mandible; molar surface of left mandible more-or-less parallel to its outer margin. Hypopharynx similar to that in Fig. 33; lingua rounded; superlingua with row of hairs along anterior margin. Maxillae (Fig. 39) not widened apically, without apical canine, with apical tuft of setae, and with cuticular tooth on medio-anterior edge of galea-lacinia; this tooth long, more than 2/3 as long as crown; maxillary palpi moderately developed, more than 3/4 as long as galea-lacina. Labium (similar to Fig. 44) with rounded glossae, lacking apical projection; paraglossae rounded; submentum widened basally.

Thorax: Thoracic nota without tubercles and often marginate lightly. Prosternum with separated longitudinal carinae; carinae slightly narrowed subapically. Dorsal surface of femora with clavate setae (Fig. 46); fore femora (Fig. 50a) with subapical band of transverse spines, often with band of basal spines, and with spines along outer margin; middle and hind femora (Fig. 50b) with spines along outer margin, without spines along inner margin; tarsal claws with 5–8 denticles.

Abdomen: Terga often with pale median stripe; terga 2–9 with pair of submedian tubercles; these tubercles small on segments 2–4, often barely discernible, well developed on segments 5–9; terga 3–7 with lamellate, imbricated gills; terga 4–9 with distinct postero-lateral projections. Abdominal sterna brown. Caudal filaments more than 2/3 as long as body, dark brown with pale annulation at apex of each segment, often with long, hair-like setae subapically; terminal filament somewhat longer than cerci.

Egg. Length (N=36) with polar cap 162–182 μm, width 116–122 μm. Egg (Figs 3, 4) oval, with polar cap; chorion covered with reticulate tubercles, and with knob-terminated coiled threads (KCT) and micropyles; each reticulation with tubercle, rarely with 2 tubercles near polar cap; micropyle with chorion sperm guide, micropylar channel, micropylar opening, and micropylar rim.

Diagnosis. The subimagoes of *C.* (*C.*) *elongatula* are similar to those of *C.* (*C.*) *levanidovae* in having infuscated wing (Figs 1, 5), but are distinguished by 1) non-expanded penes (Fig. 2), 2) lack of paired occipital spots in female, and 3) absence of 2 pairs of stripes on the abdominal terga in both sexes. The eggs can be distinguished from those of *C.* (*C.*) *levanidovae* by 1) the chorion that is covered with reticulations and 2) the larger size.

The adults of *C.* (*C.*) *elongatula* are very similar to those of *C.* (*C.*) *nigra* in the male genitalia, but may be distinguished by the relatively large body size [*C.* (*C.*) *elongatula* male 8.7–12.0 mm, female 7.3–13.3 mm; *C.* (*C.*) *nigra* male 8.6–9.0 mm, female 7.4–9.6 mm]. Subimagoes of this species can be distinguished from those of *C.* (*C.*) *nigra* by the infuscated crossveins (male and female) (Fig. 1).

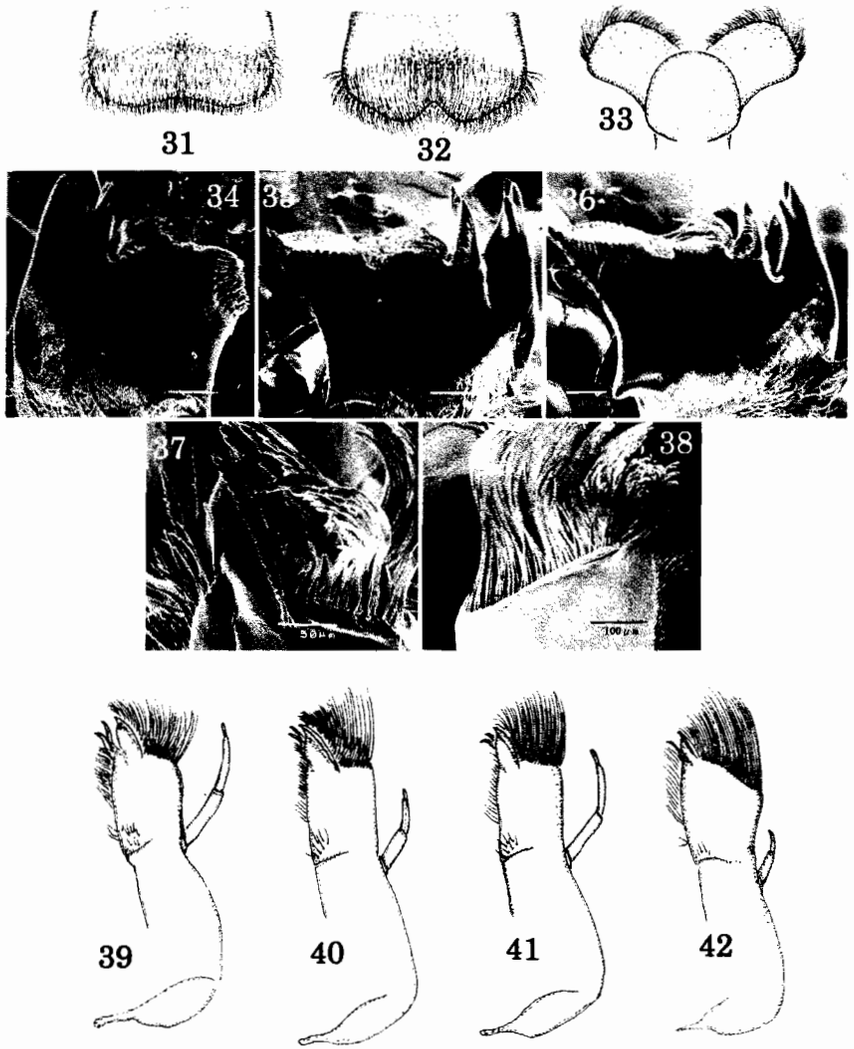
The nymphs are similar to those of *C.* (*C.*) *nigra* and it is usually difficult to separate them in the early instars; however, mature nymphs of *C.* (*C.*) *elongatula* are larger and have larger number of clavate setae on the femora (Figs 46, 50a, b). The vast majority of *C.* (*C.*) *elongatula* nymphs have an overall mottled color pattern, whereas those of *C.* (*C.*) *nigra* have a uniform color; this character, however, is not totally reliable and must be used with caution.

Eggs of this species are indistinguishable from those of *C.* (*C.*) *nigra*.

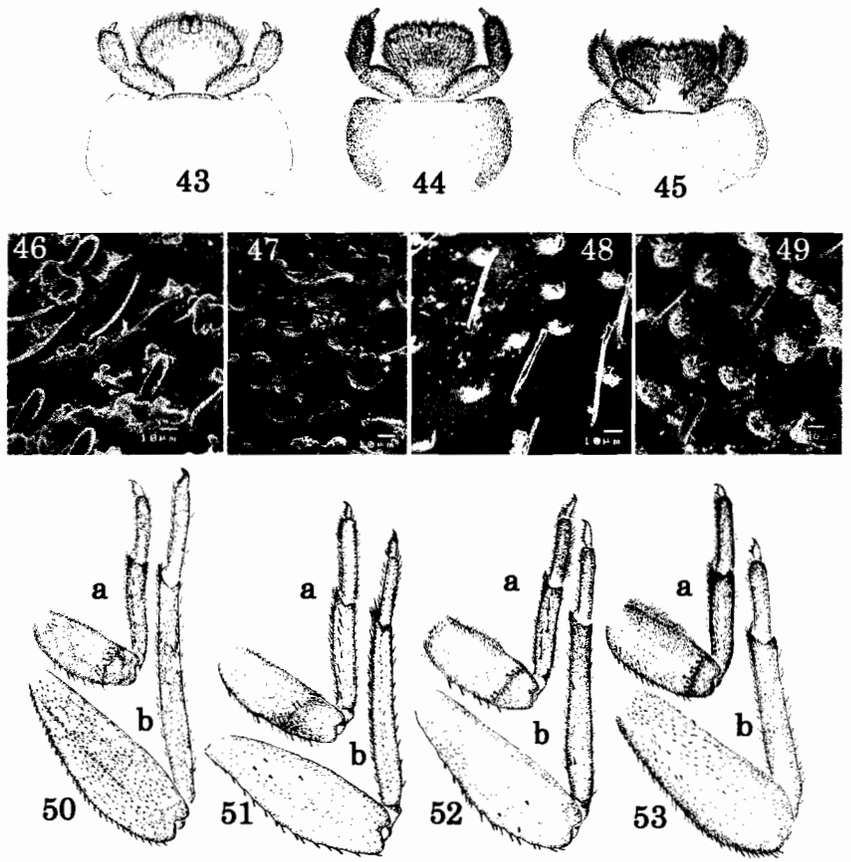
The adults of *C.* (*C.*) *elongatula* emerge early in spring, and this separates them from those of *C.* (*C.*) *nigra* (see Biology below).

Type material examined. Lectotype of *Leptophlebia elongatula* McLachlan, 1875: F, pinned, determined by A. E. Eaton, McLachlan Collection, B.M. 1938-674, H. J. Pryer [date missing].

Other material examined. JAPAN. [Hokkaido] 4N, Kaihoku, Miribetsu Riv., Ashoro, 1-V-1983, NK; 5N, Yukan Bridge, Akan Riv., Akan, 1-V-1983, NK; 1N, Obausuzawa, Atsuma, 1-XI-1995, KS; 56N, Narukawa, Nanae, 11-II-1983, TI; 8N, Satsunai Bridge, Satsunai Riv., Obihiro, 1-VI-1982, RK; 8N, Urikai Riv., Obihiro, 27-IV-1982, K. Onoyama leg.; 2N, *ibid*., 12-V-1982, K. Onoyama leg.; 2N, Amano Riv., Kaminokuni, 13-X-1987, NK; 10N, Unseki Pass, Yakumo, 15-X-1987, TN; 1N, Toya Lake, Soubetsu Riv., Toya, 17-VI-1983, Y. Nishi leg.; 12N, Kumanoyu, Rausu Riv., Rausu, 2-V-1983, NK; 7N, Rausu Riv., Rausu, 2-V-1983, NK; 1N, Shinnobusha Riv., Mashike, 21-X-1994, TI, IC; 1N, Neshikoshi Bridge, Chitose, 1-XI-1995, KS; 6N, Bibi Bridge, Bibi Riv., Chitose, 22-III-1991, TI; 1N, Kamii Bridge, Asahikawa, 22-XI-1995, KS; 1N, Nagayama Bridge, Ishikari Riv., Asahikawa, 7-VI-1997, T. Miyashita leg.; 1N, Sakuraoka Head Water, Asahikawa, 6-XI-1995, KS; 1N, Chuo Bridge, Asahikawa, 7-XI-1995, KS; 1N, Hanasaki Bridge, Asahikawa, 7-XI-1995, KS; 1N, Kagura Bridge, Asahikawa, 7-XI-1995, KS; 1N, Kotobuki Bridge, Asahikawa, 7-XI-1995, KS; 1N, Kinbun Bridge, Asahikawa, 22-XI-1995, KS; 5N, Atsubetsu Riv., Sapporo, 17-IV-1984, SU; 2N, Jozankei, Sapporo, 9-VI-1990, SI; 3N, Shirai Riv., Sapporo, 24-IV-1984, SU; 1N, Rarumazu Forest Road, Makomanai Riv., Sapporo, 22-VIII-1995, KS; 4N, near Hokkaido Fish Hatchery, Kita-kashiwagi, Eniwa, 26-VI-1987, NK; 8N, Yanbetsu Riv., Abashiri, 5-VI-1985, TI; 6N, Atsuta Riv., Atsuta, 5-XI-1993, TI, M. Nakajima and H. Yatagai leg., IC; 1N, Echanankeppu Riv., Aibetsu, 6-XI-1995, KS; 10M, 10F, 5MS, 6FS, 10N, Amemasu Riv., Teshikaga, 7-VII-1985, SI; 1MS, 5FS, Iwananosawa, Kamitoikan, Horonobe, 8-VI/26-VI-1993, M. Inoue leg., Malaise trap; 4N (1 exuvia), Yabuchi, Makomanai Riv., Kitahiyama, 10-VI-1990, SI; 1N, near Doou-highway, Sorachi Riv., Takigawa, 21-XI-1995, KS; 3N, Satsunai Riv., Nakasatsunai, 23-IV-1983, K. Kuribayashi leg.; 136N, Kuchoro Riv., Shibecha, 6-X-1991, RK, RK; 10N, Horonai Riv. in Tomakomai Experimental Forest, Tomakomai, 8-XII-1986, RK. [Honshu] **Aomori.** 2N, Amida Riv., Yomogita, 13-V-1987, SS; 2N, Asamushi Riv., Aomori, 13-V-1987, SS; 1N, Imabetsu Riv., Imabetsu, 15-V-1987, SS; 2N, Imaizumi Riv., Shiura, 16-V-1987, SS; 1N, Masu Riv., Minmaya, 16-V-1987, SS; 1N, Ikokuma Riv., Kazamaura, 17-V-1987, SS; 1N, Yunomata Riv., Ohata, 17-V-1987, SS; 1N, Wakinosawa, 18-V-1987, SS; 5N, Juni Lake, Iwasaki, 25-V-1991, T. Takahashi leg.; 1MS, Hiranuma Riv., Rokkasyo, 28-V-1994, T. Shimizu leg.; **Iwate.** 7N, Sennin Bridge, Hachimantai, 7-V-1983, collecter unknown; **Akita.** 3N, Magi, Ota, 5-I-1983, K. Aoya leg.; **Yamagata.** 1N, Ara Riv., Oguni, 1-VI-1986, TN; 1F, 2FS, Kawadai, Sasa Riv., Haguro, 19-VI-1993, SI, light; 1FS, Usugi, Oyoko Riv., Mogami, 25-V-1994, T. Kishimoto leg.; **Fukushima.** 1M, Takada Bridge, Oo Riv., Aizuwakamatsu, 2-III-1986, SI; 6N, Komadome Pass, Hinoemata Riv., Nango, 15-V-1988, SI; 13N, Shizukawa, Oo Riv., Tajima, 15-V-1988, SI; 1N, Hiyama, Murohara Riv., Namie, 16-V-1988, SI; 3N, Kashi Hot Spings, Abukuma Riv., Nishigou, 16-V-1988, SI; 6N, Ookuma Bridge, Abukuma Riv., Nishigou, 16-V-1988, SI; 10N, Tazawa, Abukuma Riv., Iwashiro, 16-V-1988, SI; 9N, Yokomuki Hot Spings, Nagase Riv., Inawashiro, 16-V-1988, SI; 1N, Mt. Azuma, Haguro Riv., 29-IX-1983, K. Ishizuka leg.; 1N, Monden, Oo Riv., Aizuwakamatsu, 15-V-1988, SI; 1N, Higashi Riv., Aizuwakamatsu, 25-IX-

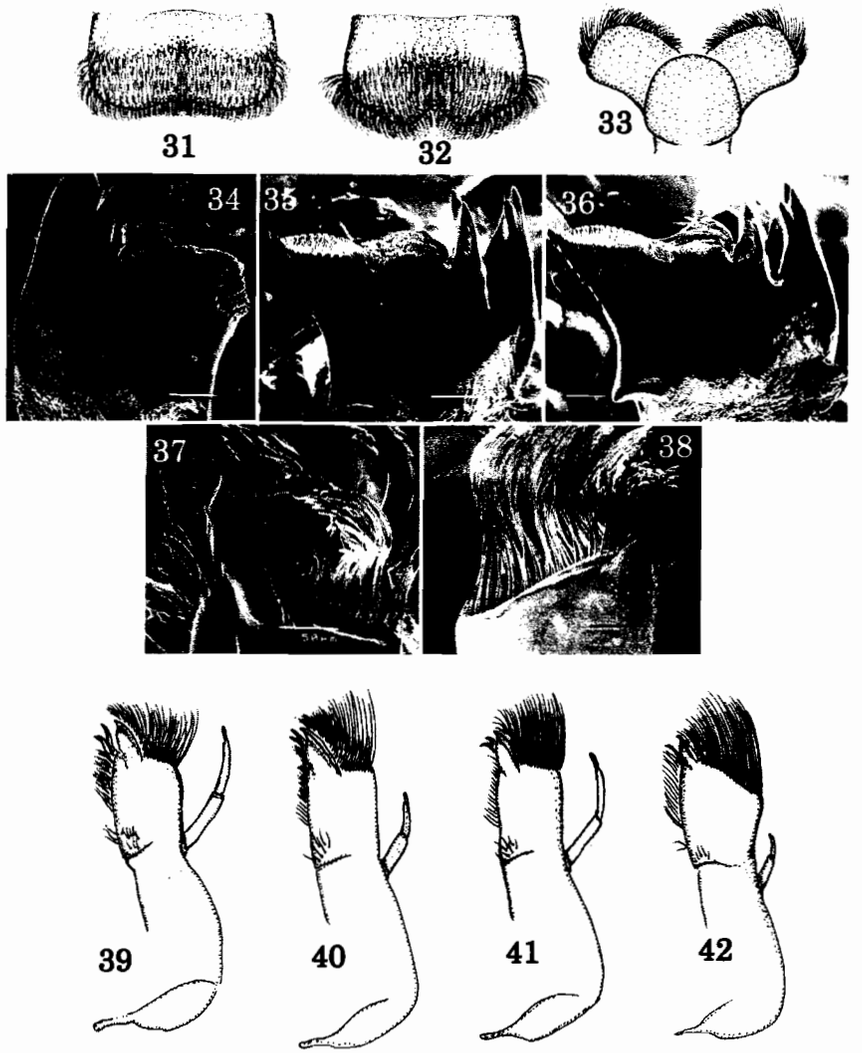


Figs 31–42. Nymphal characters of *Cincticostella* (*Cincticostella*) spp. 31, 32, labra (dorsal views): 31, *Cincticostella* (*C.*) *nigra*; 32, *C.* (*C.*) *orientalis*. 33, hypopharynx of *C.* (*C.*) *elongatula* (ventral). 34–36, mandibles: 34, right mandible of *C.* (*C.*) *nigra*; 35, left mandible of *C.* (*C.*) *nigra*; 36, left mandible of *C.* (*C.*) *orientalis*. 37–42, maxillae: 37, crown of *C.* (*C.*) *levanidovae*; 38, crown of *C.* (*C.*) *orientalis*; 39, *C.* (*C.*) *elongatula*; 40, *C.* (*C.*) *levanidovae*; 41, *C.* (*C.*) *nigra*; 42, *C.* (*C.*) *orientalis*.

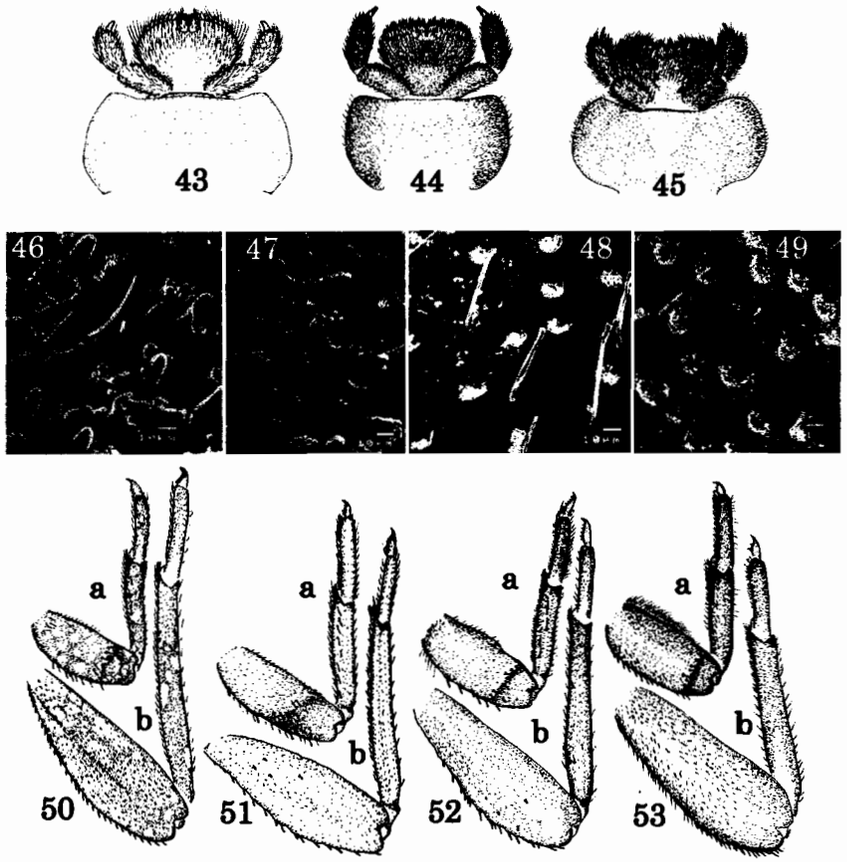


Figs 43–53. Nymphal characters of *Cincticostella* (*Cincticostella*) spp. 43–45: labia (ventral views): 43, *Cincticostella* (*C.*) *levanidovae*; 44, *C.* (*C.*) *nigra*; 45, *C.* (*C.*) *orientalis*. 46–49, surfaces of hind femora (dorsal): 46, *C.* (*C.*) *elongatula*; 47, *C.* (*C.*) *levanidovae*; 48, *C.* (*C.*) *nigra*; 49, *C.* (*C.*) *orientalis*. 50–53, right fore (a) and hind (b) legs (dorsal): 50, *C.* (*C.*) *elongatula*; 51, *C.* (*C.*) *levanidovae*; 52, *C.* (*C.*) *nigra*; 53, *C.* (*C.*) *orientalis*.

1983, K. Ishizuka leg.; 1N, Ohtani Riv., Aizuwakamatsu, 29-IX-1983, K. Ishizuka leg.; 4N, Hiyama, Murohara Riv., Namie, 16-V-1988, SI; **Ibaraki.** 2N, Miyamae, Gozenyama, 29-IV-1984, K. Satake leg.; 1FS, Ishige Bridge, Kinu Riv., Ishige, 3-IV-1994, SI; **Tochigi.** 9F, Kinu Riv., Yaita, 11-IV-1983, TN; 11N, Uchi Riv., Yaita, 13-I-1986, SU; 14N, Yu Riv., Nikko, 14-V-1988, SI; 3MS, 4FS, *ibid.*, 21-V-1986, SI; 1F, Toyamazawa Riv., Nikko, 26-V-1985, SI; 5N, Ryuzu Water Falls, Yu Riv., Nikko, 27-V-1986, SI; 2N, Yu Water Falls, Yu Riv., Nikko, 27-V-1986, SI; **Gunma.** 9N, Kinonesawa, Minakami, 27-XI-1995, H. Taira leg.; 9N, Shira Riv., Miwa, Fujimi, 28-II-1994, SI; **Chiba.** 1N, Tone Riv., Edo, Sekiyado, 14-III-2000, SI; 1M, 1MS, 1F, 1FS, 5N (1 exuvia), Byakko Riv., Futsu, 26-III to 11-IV-1996, H. Taira leg.; 4N, Ninotaki Riv.,



Figs 31–42. Nymphal characters of *Cincticostella* (*Cincticostella*) spp. 31, 32, labra (dorsal views): 31, *Cincticostella* (*C.*) *nigra*; 32, *C.* (*C.*) *orientalis*. 33, hypopharynx of *C.* (*C.*) *elongatula* (ventral). 34–36, mandibles: 34, right mandible of *C.* (*C.*) *nigra*; 35, left mandible of *C.* (*C.*) *nigra*; 36, left mandible of *C.* (*C.*) *orientalis*. 37–42, maxillae: 37, crown of *C.* (*C.*) *levanidovae*; 38, crown of *C.* (*C.*) *orientalis*; 39, *C.* (*C.*) *elongatula*; 40, *C.* (*C.*) *levanidovae*; 41, *C.* (*C.*) *nigra*; 42, *C.* (*C.*) *orientalis*.



Figs 43–53. Nymphal characters of *Cincticostella* (*Cincticostella*) spp. 43–45: labia (ventral views): 43, *Cincticostella* (*C.*) *levanidovae*; 44, *C.* (*C.*) *nigra*; 45, *C.* (*C.*) *orientalis*. 46–49, surfaces of hind femora (dorsal): 46, *C.* (*C.*) *elongatula*; 47, *C.* (*C.*) *levanidovae*; 48, *C.* (*C.*) *nigra*; 49, *C.* (*C.*) *orientalis*. 50–53, right fore (a) and hind (b) legs (dorsal): 50, *C.* (*C.*) *elongatula*; 51, *C.* (*C.*) *levanidovae*; 52, *C.* (*C.*) *nigra*; 53, *C.* (*C.*) *orientalis*.

1983, K. Ishizuka leg.; 1N, Ohtani Riv., Aizuwakamatsu, 29-IX-1983, K. Ishizuka leg.; 4N, Hiyama, Murohara Riv., Namie, 16-V-1988, SI; **Ibaraki.** 2N, Miyamae, Gozenyama, 29-IV-1984, K. Satake leg.; 1FS, Ishige Bridge, Kinu Riv., Ishige, 3-IV-1994, SI; **Tochigi.** 9F, Kinu Riv., Yaita, 11-IV-1983, TN; 11N, Uchi Riv., Yaita, 13-I-1986, SU; 14N, Yu Riv., Nikko, 14-V-1988, SI; 3MS, 4FS, *ibid.*, 21-V-1986, SI; 1F, Toyamazawa Riv., Nikko, 26-V-1985, SI; 5N, Ryuzu Water Falls, Yu Riv., Nikko, 27-V-1986, SI; 2N, Yu Water Falls, Yu Riv., Nikko, 27-V-1986, SI; **Gunma.** 9N, Kinonesawa, Minakami, 27-XI-1995, H. Taira leg.; 9N, Shira Riv., Miwa, Fujimi, 28-II-1994, SI; **Chiba.** 1N, Tone Riv., Edo, Sekiyado, 14-III-2000, SI; 1M, 1MS, 1F, 1FS, 5N (1 exuvia), Byakko Riv., Futsu, 26-III to 11-IV-1996, H. Taira leg.; 4N, Ninotaki Riv.,

Maruyama, 3-IV-1996, H. Taira leg.; **Tokyo.** 3N, Mitousawa Riv., Hinohara, 12-V-1986, TN; 4N, Tsurumi Riv., Machida, 18-II-1985, NK; 4N, Shinkouji, Tsurumi Riv., Machida, 18-III-1985, NK; **Kanagawa.** 20N, Hisari Riv., Yamakita, 10-IV-1978, SU; 5N, Shiraishizawa, Yamakita, 27-IV-1984, SI; 3N, *ibid.*, 30-VIII-1983, SI; 2N, Makuyama, Niizaki Riv., Yugawara, 15-III-1988, SI; 11N, Shirogane Bridge, Niizaki Riv., Yugawara, 15-III-1988, SI; 1N, Kaizawa, Minamiashigara, 20-I-1980, SU; 1M, Sekiba, Kari Riv., Minamiashigara, 23-IV-1984, SI; 30N, Kamozawa, Nakamura Riv., Nakai, 31-I-1985, SI; 8N, Nagatsuda, Yokohama, 7-II-1985, SU; 1M, 30N (1 exuvia), Kawajiri, Sakai Riv., Shiroyama, 9-III-1987, SI; 2N, Maeda Riv., Hayama, 9-IV-1988, SI; 1F, 1N (exuvia), Morito Riv., Hayama, 6-V-1988, SI; **Niigata.** 20N, Katsura, Arakawa, 1-III-1986, S. Togashi leg.; 1N, Owada, Onna Riv., Arakawa, 1-VI-1986, TN; 1M, 1F, 2N, Nakazato, Daigenta Riv., Yuzawa, 13-V-1989, SI; 1N, Gomisawa Riv., Irihirose, 14-V-1989, SI; 1N, Koinomatazawa Riv., Yunotani, 20-IV-1992, SI; 4N, Nakaarasawa Riv., Yunotani, 20-IV-1992, SI; 4N, Kuji Riv., Ryotsu, Sado Is., 31-III-1991, HM; 25N, Umezu Riv., Ryotsu, Sado Is., 31-III-1991, HM; **Toyama.** 5N, Niikawa Bridge, Kurobe Riv., Kurobe, 26-IV-1992, S. Tanaka leg.; **Ishikawa.** 4N, Kiochi Riv., Nanao, 20-III-1988, NK; **Fukui.** 1N, Mizukoshi Bridge, Asuwa Riv., Ikeda, 23-III-1993, S. Mochida leg.; **Yamanashi.** 4N, Taiko Riv., Makioka, 17-IV-1996, H. Taira leg.; 1N, Hondani, Ichinose, Enzan, 26-IV-1986, SI; 8N, Nakajimagawa Bridge, Ichinose, Enzan, 26-IV-1986, SI; **Nagano.** 1N, Gonbei Pass, Niekawa, 3-V-1986, SI; 1FS, Itabashi, Minamimaki, 13-V-1989, SI; 1N, Kuzu Hot Spings, Omachi, 16-X-1996, Y. Marunouchi leg.; 4N, Jizou Pass, Kuroki Riv., Kisofukushima, 3-V-1986, SI; **Shizuoka.** 9N, Amagi Bridge, Kano Riv., Amagiyugashima, 4-III-1985, SI; 3N, Iwadono, Aono Riv., Minamiizu, 4-III-1985, SI; 1N, Kawazu Bridge, Kawazu Riv., Kawazu, 4-III-1985, SI; 10N, Oonabe, Kawazu Riv., Kawazu, 4-III-1985, SI; 6N, upper reaches of Kawazu Riv., Kawazu, 4-III-1985, SI; 4N, Higashizawa (433 m a.s.l.), Inago Riv., Shibakawa, 23-III-1990, T. Kondo leg.; 2N, Nishiyama, Shiba Riv., Shibakawa, 23-III-1990, T. Kondo leg.; **Aichi.** 3N, Kanda, Tashiro Riv., Shitara, 6-IV-1994, Y. Shibata leg.; **Mie.** 7N, Komono, 26-III-1989, H. Morita leg.; 5N, Kamiaiba, Fujiwara, 8-III-1987, H. Morita leg.; **Shiga.** 4N, Ado Riv., Umenoki, Otsu, 20-IV-1985, SI; 4N, Kamihashi, Sakamoto, Otsu, 20-IV-1985, SI; 20N, Uryu, Azai, 21-I-1992, Tagawa leg.; 2N, Mano Riv., Otsu, 30-III-1987, NK; 1MS, 5N, Wani Riv., Shiga, 30-III-1987, NK; **Kyoto.** 15M, Matsuo Bridge, Katsura Riv., 17-V-1979, YT, light; 4N, Ichihara, Kurama Riv., Shizuichi-ichihara, 20-IV-1985, SI; 1M, 1F, *ibid.*, 18-IV-1935, KI (as *Ephemerella nigra*), CERK; 1F, Mt. Atago, 31-V-1931, KI (as *E. nigra*), CERK; 5F, Azogadani Riv., Kurama-kifune, 20-IV-1987, YT; 1F, Kifune, Kurama-kifune, 31-V-1930, KI (as *E. nigra*), CERK; 10N, Kurumazaka, Kumogahata, Kurama-kifune, 25-II-1978, YT; 3N (2 exuviae), Kamiya Riv., 15-IV-1931, KI (as *E. nigra*), CERK; 1F, 1N (exuvia), locality unknown, 22-IV-1935, KI (as *E. nigra*), CERK; 1M, 1F, *ibid.*, ?-IV-1935, KI (as *E. nigra*), CERK; **Hyogo.** 1N, Nakama Riv., Ohya, 29/30-XI-1991, YT and K. Tanida leg.; **Nara.** 2N, Yoshino Riv., Yoshino, Wasamata, Kitayama, 1-IV-1987, K. Tanida leg.; 2N, Chaya Bridge, Yoshino Riv., Tenkawa, 19-V-1992, HM; 1N, Miterai Valley, Kawakami Riv., Tenkawa, 19-V-1992, HM; 4N, Yoshino Riv., Tenkawa, 19-V-1992, HM; **Tottori.** 5N, Sou, Hino Riv., Mizokuchi, 17-II-1980, S. Tanaka leg.; 1N, Tono Dam, Fukuro Riv., 27-I-1989, Y. Masuda leg.; 4N, Sou, Hino Riv., Mizokuchi, 2-III-1980, S. Tanaka leg.; **Shimane.** 2N, Iwamiyokota, Hikimi Riv., Masuda, 19-III-1989, SI; 5N, Takatsu, Hikimi Riv., Hikimi, 19-III-1989, SI; 15N, Kasuga Riv., Fuse, Oki Is., 4-IV-1991, F. Hayashi leg.; **Okayama.** 3N, Maga Hot Springs,

Katsuyama, 10-IV-1990, I. Yoshitaka leg.; 1N, Kuroki, Okutsu, 25-III-1990, I. Yoshitaka leg.; 45N, Hirusen Plateau, Asahi Riv., 25-IV-1988, NK; 18N, Kudani, Ukai Riv., Mitsu, 27-II-1991, SI; **Hiroshima.** 8N, Yusaka Riv., Karuga, Asakita, 16-IV-1987, K. Kamei leg.; 2N, Tsuzurahara, Yuki, 17-IV-1986, K. Kamei leg.; 15N, Matsubara, Matsubara Riv., Togouchi, 19-III-1989, SI; 3N, Mt. Shinnyu, Matsubara, Ota Riv., Togouchi, 19-III-1989, SI; 20N, Higashiyawatabara, Ota Riv., Geihoku, 19-III-1989, SI; **Yamaguchi.** 10N, Akagane, Zomeki Riv., Ato, 20-III-1989, SI; 2N, Daigo Riv., Yuya, 20-III-1989, SI; 3N, Hotoke Pass, Yunoki, Saba Riv., Tokuji, 20-III-1989, SI; 1N, Ikuno Riv., Ato, 20-III-1989, SI; 1N, Misumi Riv., Misumi, 20-III-1989, SI; 7N, Shijuhasse Riv., Ogori, 20-III-1989, SI. [Kyushu] **Fukuoka.** 7N, Mt. Hiko, Notori Riv., Amagi, 21-III-1989, SI; 5N, Ino Riv., Hisayama, 24-III-1988, SI; 1N, Michihara, Siba Riv. (80 m a.s.l.), Kitakyushu, 11-II-1996, KH; 1N, Shojidake Bridge, Hikosan Riv. (450 m a.s.l.), Soeda, 27-IV-1996, KH; 1N, Chokichi Youth House, Shiba Riv. (160 m a.s.l.), Kitakyushu, 3-I-1996, KH; 1N, Hatake Dam, Kuro Riv. (80 m a.s.l.), Kitakyushu, 30-III-1996, KH; **Saga.** 30N, Jinnai Bridge, Kose Riv., 6-I-1989, Y. Kawasaki leg.; 3N, Kawakami, Kose Riv., Yamato, 6-I-1989, Y. Kawasaki leg.; **Nagasaki.** 5N, Miyadai, Omura, 3-XI-1993, SI; **Kumamoto.** 5N, Ohara Riv. (900 m a.s.l.), Yatsushiro, 23-III-1988, Y. Oda leg.; 2M, 2F, 1MS, 1FS, 6N (exuviae), Honokibaru, Kuma Riv., Mizukami, 25-III-1989, SI; **Oita.** 4N, Masaki, Yamaguni Riv., Yabakei, 21-III-1989, SI; 5N, Todoro Riv., Yabakei, 21-III-1989, SI; 2N, Tochigi, Yamaguni Riv. (100 m a.s.l.), Yabakei, 6-V-1996, KH; 9N, Yunohira, Oita Riv., Shonai, 22-III-1989, SI; 1N, Shingai, Yamaguni Riv. (320 m a.s.l.), Yamakuni, 15-I-1996, KH; 1N, Aishi Bridge, Yamaguni Riv. (430 m a.s.l.), Yamaguni, 6-V-1996, KH; **Miyazaki.** 1M, 1FS, 2N (exuviae), Sendai Riv., Ebino, 23-III-1989, SI; 1FS, 1N (exuvia), Takemotodani Riv., Hitotsuse Riv., Nishimera, 25-III-1989, SI; 2FS, 2N (exuviae), Yuyama Pass, Yadate Riv., Yadate, Shiiba, 25-III-1989, SI; 1N, Mimi Riv., Saigo, 22-III-1988, SI; **Kagoshima.** 3N, Hanawatari Riv., Kaseta, 10-III-1986, Y. Ueno leg.; 1N, Shinzan, Hanawatari Riv., Kaseta, 22-XI-1985, Y. Ueno leg. **RUSSIA.** [Kunashir Is.] 2N, Philatovka Riv., 2 km from the mouth, 15-VI-1982, collector unknown.

Discussion. Horasawa (1931) described the female imago and female subimago from Tokyo, Honshu, central Japan, under the name of *Ephemerella nigra*. Horasawa's (1931) wing description of the female subimago agrees with that of *C.* (*C.*) *elongatula* because *C.* (*C.*) *elongatula* is the only species of *Cincticostella* in Honshu with infuscated crossveins.

Imanishi (1937) described the male and female imagoes and the female subimago obtained from reared nymphs under the name of *Ephemerella nigra*. I examined these specimens in Imanishi's collection in CERK and found that all the specimens identified by Imanishi as *E. nigra* are actually *C.* (*C.*) *elongatula*. I also suspect Allen's (1971) *E.* (*C.*) *nigra* to be *C.* (*C.*) *elongatula*; although I have not examined his specimens (not located in INHS, Jan Peters, pers. comm. 1993), the hind leg in his illustration (p. 515, fig. 9) agrees with that of *C.* (*C.*) *elongatula*, in particular because the dorsal surface of the femur is densely covered with short setae. After Imanishi's (1937) description of the adult as *E. nigra*, the adults of true *C.* (*C.*) *elongatula* have frequently been misidentified with *E. nigra* by many authors (Uéno 1950; Tshernova 1972; Tshernova *et al.* 1986).

Gose (1962) reported "*Ephemerella* sp. EC" based on materials from Chichibu, Saitama, Honshu (M. Okuma, pers. comm. 1990). Later, this was named *Ephemerella* (*Cincticostella*) *okumai* by Gose himself (1980a), being distinguished

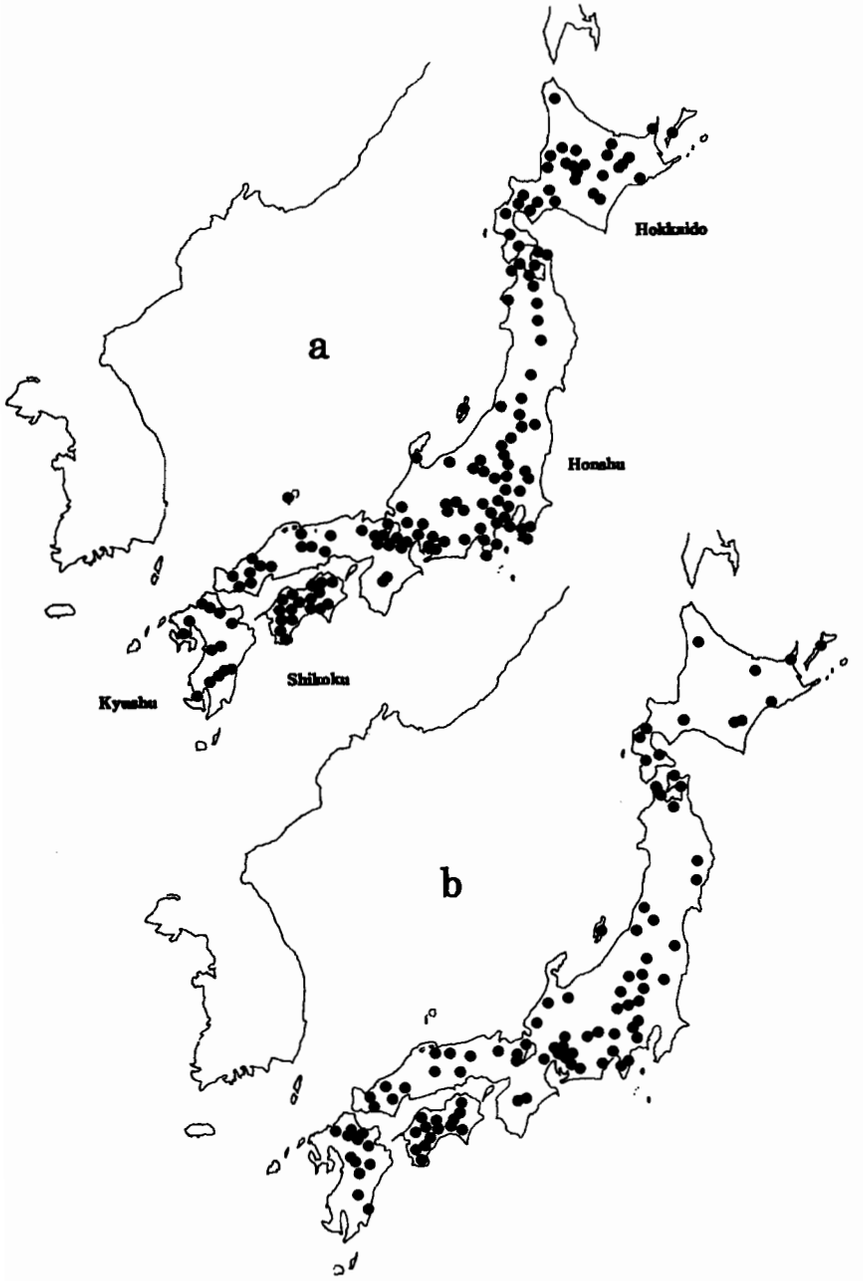


Fig. 54. Distribution of *Cincticostella* (*Cincticostella*) *elongatula* (a) and *C.* (*C.*) *nigra* (b).

from *E.* (*C.*) *nigra* by the shape of the penes in the male imago and by the caudal filaments with numerous intersegmental setae in the nymph. Examining numerous nymphal and adult specimens of *E.* (*C.*) *okumai* and *E.* (*C.*) *nigra*, I found that these characters are not reliable to distinguish them. Although the latter is one of the characters of *E.* (*C.*) *okumai*, it is unstable and sometimes lacking. Since Gose's (1980a) type specimen of *E.* (*C.*) *okumai* is lost (K. Gose, pers. comm. 1995), I compared nymphs and reared male and female imagoes of *E.* (*C.*) *okumai* determined by Gose with the lectotype of *E. elongatula* and found them to be indistinguishable morphologically. Although the lectotype was not in good condition, the wing coloration and body size (fore wing length 13.9 mm) agree well with those of *E.* (*C.*) *okumai*. Therefore, I am proposing herein to synonymize *E.* (*C.*) *okumai* with *E. elongatula*.

Distribution. The geographic range of this species extends throughout Japan, excluding the Okinawa Islands and Tsushima Island, and includes Kunashir Island. (Fig. 54a). Ulmer (1929) reported *E. elongatula* from Japan and northern China and redescribed the imagoes, but he himself later questioned the occurrence of this species in China (Ulmer 1935–1936).

Biology. The nymphs of *C.* (*C.*) *elongatula* inhabit various lotic environments. They are commonly found in medium to large rapid streams but have been collected as well from small streams only a few centimeters wide. In Kanagawa Prefecture this species can be found in all streams except polluted ones. They live on various types of bottom, but are most commonly found among rocks, gravel, debris, and dead leaves. Nymphs of *C.* (*C.*) *elongatula* coexist with those of *C.* (*C.*) *nigra* in many areas within their distributional ranges, but the habitat of *C.* (*C.*) *elongatula* seems to extend into streams at lower altitudes (Ishiwata 2000).

The present species is clearly univoltine. Nymphs of *C.* (*C.*) *elongatula* are collected in September in a very early stage, and mature in April (Ishiwata 1989). All the adults emerge in April about 1–1.5 months earlier than those of *C.* (*C.*) *nigra* (Fig. 56). The mating flight of *C.* (*C.*) *elongatula* (under the name *E. nigra*) was observed in Kyoto, high in the air above a valley under full sunlight (Imanishi 1937).

Cincticostella (*Cincticostella*) *levanidovae* (Tshernova, 1952)

[Japanese name: Kasutanea-madara-kagerou]

(Figs 5–8, 18, 22, 28, 37, 40, 43, 47, 51a, b, 55)

Ephemerella sp. (tentatively named "nay") (in part): Imanishi 1940: 206 [des. (N), fig. (N), key (N)]. [N, Shitouhe, Mudanjiang, Manchuria (Jingpo Hu, Heillongjang, China), 25-X-1938, D. Miyaji, not located in CERK, probably lost]; Gose 1962: 15 [fig. (N), key (N)].

Ephemerella levanidovae Tshernova, 1952: 274 [des. (N), fig. (N), key (N)]. [Lectotype N, designated by Kluge (1995); type locality, Khor Riv., tributary of Ussuri Riv., Russia; lectotype deposition, ZIS]; Tshernova 1958: 74; Edmunds 1959: 545; Bajkova 1962: 205 [key (N)]; Levanidova 1968: 265; Bajkova 1979: 16 (as junior synonym of *E. orientalis*).

Ephemerella (*Serratella*) *levanidovae*: Edmunds 1959: 545.

Ephemerella (*Cincticostella*) *castanea* Allen, 1971: 514 [des. (N), fig. (N)]. [Holotype male N, 3-IV-1960, G. Field; type locality, Kwang Nung, Korea; holotype deposi-

Fig. 55. Distribution of *Cincticostella* (*Cincticostella*) *levanidovae* (○) and *C.* (*C.*) *orientalis* (●).

tion, USL, not located]; Allen 1975: 18 [des. (N), key (N)]; Yoon and Kim 1981: 38 [des. (N), fig. (N), key (N)]; Gose 1988: 26 [fig. (N), key (N)]. [Synonymized by Bae *et al.* 1998]

Ephemerella (*Cincticostella*) *levanidovae*: Allen 1971: 516 [des. (N); fig. (N)]; 1975: 21 [des. (N), key (N)]; Tshernova *et al.* 1986: 138 [key (sex?)]; Kluge 1995: 41; 1997: 211 [fig. (N), key (N)]; Bae *et al.* 1998: 91.

Ephemerella (*Cincticostella*) *delicata* Allen, 1971: 517 [des. (N), key (N)], described as new species based on Imanishi's (1940) "*Ephemerella* nay". [Holotype N, see *Ephemerella* sp. "nay", above]; Allen 1975: 19 [des. (N), key (N)]; Bajkova 1979: 16 (as junior synonym of *E. orientalis* together with *E. levanidovae*).

Ephemerella (*Cincticostella*) *costanea* [sic]: Gose 1980a: 288 [fig. (N), key (N)]; 1985: 26 [fig. (N), key (N)].

Ephemerella (*Cincticostella*) *orientalis*: Gose 1980a: 288 [fig. (N), key (N)]; 1985: 26 [fig. (N), key (N)]. [Not Tshernova, 1952]

Cincticostella levanidovae: Tiunova 1984: 49 (revived from synonym of *E. orientalis* by Bajkova 1979); Bae 1997: 409; Yoon and Bae 1997: 45; Bae *et al.* 2000: 393; Ishiwata 2001a: 60.

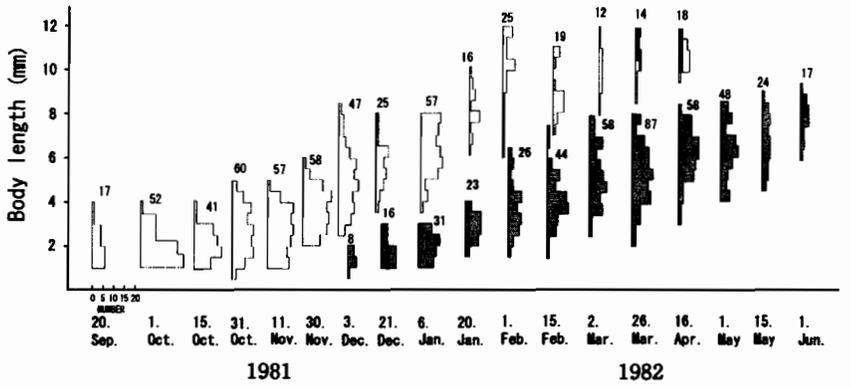


Fig. 56. Seasonal change in frequency distributions of nymphal length in *Cincticostella* (*Cincticostella*) *elongatula* (white) and *C.* (*C.*) *nigra* (gray). Numbers on each bar are numbers of nymphs collected (scale at bottom left). Black areas correspond to the final stage nymphs with dark wing pads just before emergence.

Description. *Male imago*. Length (N=29): Body 7.7–11.7 mm; fore wing 8.7–10.3 mm; Hind wing 2.0–3.3 mm; caudal filaments 9.9–13.1 mm.

Head: Color chocolate brown; upper part of compound eye of living specimen light brown, lower part black.

Thorax: Pronotum reddish brown to blackish brown, usually with black spots post-laterally. Basisternum of prosternum reddish brown to blackish brown, with longitudinal carinae; carinae slightly converging anteriorly (maximum width between lateral margins of carina less than twice minimum width) (Fig. 28); furcasternum reddish brown to blackish brown. Mesonotum (Fig. 18) reddish brown to blackish brown; lateroparapsidal sutures (LPs) not terminating at MPs; scutellum without posterior prolongation, also lacking pair of membranous posterior lamellae. Mesosternum brown; basisternum reddish brown to blackish brown, rectangular or somewhat narrowed anteriorly; furcasternal protuberances narrowed posteriorly. Forewings hyaline; stigmatic area opaque; basal costal crossveins not developed; primary longitudinal veins yellowish brown basally, dark brown apically; crossvein somewhat dark. Fore tibiae about 1.5 times as long as fore femora; fore tarsi ranked 2, 3, 4, 5, and 1 in order of length; middle and hind legs yellowish brown; tarsi often dark brown.

Abdomen: Terga yellowish brown to reddish brown, with 2 pairs of dark stripes. Sterna pale, with distinct lateral black dots, often with markings on each sternum. Penes expanded (Fig. 6); second segment of genital forceps sharply angled inward and with subapical constriction; third segment less than twice as long as broad. Caudal filaments dark brown, with brown annulations; terminal filament

somewhat longer than cerci.

Female imago. Length (N=49): Body 7.8–12.0 mm; fore wing 7.9–12.0 mm; hindwing 1.6–3.3 mm; caudal filaments 8.5–12.7 mm.

Other features as in male imago except for usual sexual differences and following characters:

Head: Color reddish brown to blackish brown, usually with pair of occipital spots.

Thorax: Pronotum with black spots laterally. Width of prosternal carinae somewhat greater than in male imago. Mesobasisternum nearly quadrate; furcasternal protuberances parallel (sometimes converging posteriorly), wider than those of male. Fore legs light brown; fore tibiae about as long as fore femora.

Abdomen: Terga yellowish brown to reddish brown. Apex of sternum 9 truncate with shallowly rounded median emargination.

Male subimago. As in male imago except for duller coloration and following characters:

Head: Color reddish brown, usually with pair of occipital spots; upper part of compound eye of live specimen reddish brown, lower part black.

Thorax: Pronotum yellowish brown to reddish brown, sometimes with membranous tubercle posteriorly, often with dark spots laterally. Mesonotum (Fig. 22) sometimes with membranous tubercle at junction of mesonotal suture (MNs); pigmented sclerotization on medioparapsidal sutures (MPs) elongate (length of sclerotization 1/4–1/3 as long as MPs); scutellum with posterior prolongation, and lacking pair of membranous posterior lamellae. Wings brown; crossvein infuscated. Middle and hind legs yellowish brown; tarsi often dark brown.

Abdomen: Terga light brown to dark brown, with 2 pairs of dark stripes. Caudal filaments subequal to, or somewhat shorter than body length.

Female subimago. As in male subimago except for following characters:

Head: Color reddish brown to dark brown.

Thorax: Width of prosternal carinae somewhat greater than in male imago. Width of mesobasisternum subequal in length to that of male subimago; furcasternal protuberances wider.

Abdomen: Apex of sternum 9 truncate, often with shallowly rounded median emargination.

Mature nymph. Length (N=30): Body 6.6–9.8 mm; caudal filaments 6.5–10.6 mm.

Coloration: General color light brown to dark brown.

Head: Head without tubercles; genae rounded. Labrum (similar to Fig. 31) with broad, shallow emargination. Mandibles (similar to Figs 34, 35) with lateral margin weakly rounded; incisors of right mandible narrow; molar surface of left mandible more-or-less parallel to outer margin of mandible. Hypopharynx similar to that in Fig. 33; lingua rounded; superlingua with row of hairs along anterior margin. Maxillae (Fig. 37) not widened apically, lacking apical canine, with apical tuft of setae, and with cuticular tooth on medio-anterior edge of galea-lacinia; this tooth long, more than 2/3 as long as crown; maxillary palpi moderately developed, less than 2/3 as long as galea-lacina. Labium (Fig. 43) with rounded glossae, sometimes with apical projection; paraglossae rounded; submentum slightly widened basally.

Thorax: Thoracic nota without tubercles. Prosternum with separated longitudinal carinae; carinae slightly converging subapically. Dorsal surface of femora entirely covered with small, depressed spots (Fig. 47); fore femora (Fig. 51a) with

subapical band of transverse spines and with spines along outer margin; middle and hind femora (Fig. 51b) with spines along outer margin; inner margin lacking spines; tarsal claws with 5–8 denticles.

Abdomen: Terga reddish brown with 2 pairs of dark brown submedian stripes, 2 stripes in line with pair of dorsal abdominal tubercles, others on outside of abdominal tubercles; terga 2–9 with pair of submedian tubercles; these tubercles small on segments 2–4 and 9, often barely discernible, well developed on segments 5–8; terga 3–7 with lamellate, imbricated gills; terga 4–9 with distinct postero-lateral projections. Abdominal sterna brown; sterna 2–8 with sublateral, dark brown maculae, pair of submedian spots, and thin, chevron-shaped markings (Allen 1971: 514). Caudal filaments more than 2/3 as long as body, dark brown with pale annulation at apex of each segment, lacking long, hair-like setae subapically; terminal filament somewhat longer than cerci.

Egg. Length (N=31) with polar cap 132–165 μm, width 102–110 μm. Egg (Figs 7, 8) oval, with polar cap; chorion covered with broken reticulations, and with knob-terminated coiled threads (KCT) and micropyles; each reticulation with 4–6 tubercles; micropyle with chorion sperm guide, micropylar channel, micropylar opening, and micropylar rim.

Diagnosis. *Cincticostella* (*C.*) *levanidovae* is distinguished from *C.* (*C.*) *elongatula* and *C.* (*C.*) *nigra* by the following characters. In the adults, 1) expanded penes in male imagoes and subimagoes (Fig. 6), 2) paired occipital spots in female imagoes and subimagoes, and 3) two stripes on abdominal terga in both sexes of imagoes and subimagoes. In the mature nymphs, 1) depressed small spots on dorsal surface of femora (Fig. 47) and 2) two stripes on abdominal terga. In the eggs (Figs 7, 8), 1) chorion covered with broken reticulations and 2) relatively smaller size.

Type material examined. Lectotype of *Ephemerella levanidovae* Tshernova, 1952: N, in alcohol, 7-V-1949, V. Ya. Levanidova. Paratype of *Ephemerella* (*Cincticostella*) *castanea* Allen, 1971: N, in alcohol, Kwang Nung, Kyonggi Prov., Korea, 3-IV-1960, G. Field; paratype deposition, CAS.

Other material examined. JAPAN. [Tsushima Is.] 4N, Sago Riv. (300 m a.s.l.), Kamiagata, 26-III-1988, SI; 8N, Koutsuki Riv., Izuhara, 25-III-1988, SI; 10M, 5MS, 8F, 6FS, Se Riv., Izuhara, collected 25-III-1988, emerged 4–12-IV-1988, by S. Ishiwata; 10N, Uchiyama, Se Riv., Izuhara, 18-IV-1988, TN; 1N, Asamo, Asamo Riv., Izuhara, 18-IV-1988, TN; 1N, Sasu, Izuhara, 18-IV-1988, TN; 2N, Shushi, Kamitsushima, 18-IV-1988, TN. **KOREA.** 10M, 5MS, 10F, 10FS, 5N, Kapsa, Mt. Kyeryong, Kongju, Chungchaong-nam Prov., 3-IV-1982, Y. J. Bae leg.; 1MS, Kangrimchon (Stream) above village, Pugok Riv., Chiaksan National Park, Kangwon Prov., 19-V-2000, SI. **RUSSIA.** [Primor'ye] 1M, 2F, 1N (exuvia), Kedrovaya Riv., Kedrovaya Pad Reserve, 4-VI-1990, T. Tiunova leg.; 3N, *ibid*., 22-V-1992, SI; 4F, 2MS, 12FS, 1N, *ibid*., 9-VI-1973, I. Levanidova leg.; 1N, *ibid*., 6-VI-1962, A. Rosnitsin leg.; 3M, Soboliniy Stream, Lazovsky Reserve, 24-VI-1978, T. Vshivkova leg.; 1N (exuvia), Saratovka, Ussuri Riv., 29-V-1992, SI; 10M, 5MS, 10F, 10FS, *ibid*., 28-V-1992, SI, light.

Discussion. This species was first reported by Imanishi (1940) as "*Ephemerella* nay" based on nymphs from Manchuria. Allen (1971) named Imanishi's "*Ephemerella* nay" as *Ephemerella* (*Cincticostella*) *delicata* and designated Imanishi's (1940: fig. 18) specimen as the holotype. *Ephemerella* (*Cincticostella*) *delicata* and *E. levanidovae* were synonymized with *Ephemerella orientalis* by Bajkova (1979). On the other hand, Bae *et al*. (2000) stated that Imanishi's "*Ephemerella* nay"

(as *E.* (*C.*) *delicata*) belongs probably to *C. levanidovae*. Although I could not examine the type specimen (*C.*) *delicata* (not located in CERK, probably lost), the nymphal characters described by Imanishi (1940), e.g., the abdominal terga with 2 pairs of dark longitudinal stripes and with pair of dorsal abdominal tubercles, coincides with the chars of *E. levanidovae*. Based on the lectotype of *E. levanidovae* and the reared specimens from the Russian Far East, I agree with Bajkova (1979) about the synonymy of *E.* (*C.*) *delicata* and *E. levanidovae*, but not with the synonymy of these and *Entalis* (see Discussion for *C.* (*C.*) *orientalis* below).

Ephemerella (*Cincticostella*) *castanea* was described by Allen (1971) from nymphs collected in Korea. Imanishi and Bae (1988b) reported and described the male adult from Korea. Ishiwata (1989) reported this species from Tsushima Island, Japan. After examination of type specimens of *E. levanidovae* and specimens of *E.* (*C.*) *castanea* collected from the type locality in Korea, Bae *et al.* (1998) synonymized *E. castanea* with *E. levanidovae*. I compared paratypes (labeled "paratopotypes") of *E. castanea* (holotype not located in the USL, Jan Peters, pers. comm. 1995) and specimens of *castanea* from Korea and Japan with the lectotype of *E. levanidovae*. The features that distinguish *E. castanea* from other species of *Cincticostella* according to Allen (1971) fall within the individual variation of *E. levanidovae*. Thus, I agree with Bae *et al.*'s (1998) opinion that *E.* (*C.*) *castanea* is a junior synonym of *E. levanidovae*.

Bajkova (1962) reported *nigra* from Primor'ye (1400 m a.s.l.), and Tshernova *et al.* (1986) reported it from western Primor'ye, Sakhalin, and the south Kuril Is. But this continental material is most likely to be *C.* (*C.*) *levanidovae*.

Distribution. The geographical range of *C.* (*C.*) *levanidovae* extends from Tsushima Island, Japan, through Korea to the Russian Far East (Fig. 55).

Biology. In Tsushima Is. the nymphs of *C.* (*C.*) *levanidovae* have been collected in mountain streams. They are commonly found in medium to large, rapid streams but are also collect small streams. Levanidova (1968) stated that in the Amur River they occur on aquatic plants rather than on the river bottom. I found them most commonly among rocks and gravel in stream riffles, or sometimes in debris. In Tsushima Island, mature nymphs were collected in March and April. On the other hand, in Primor'ye, mature nymphs were found in June (Levanidova 1968).

Cincticostella (*Cincticostella*) *nigra* (Uéno, 1928)

[Japaname: Kuro-madara-kagerou]

(Figs 9–12, 19, 23, 25, 29, 31, 33–35, 41, 44, 48, 52a, b, 54b, 56)

Ephemerella nigra Uéno, 1931 [des. (N), fig. (N)]. [Lectotype N (designated herein); type locality, Tada-zawa Riv., at about 1400 m a.s.l., near Yumoto Hot Springs in Nikko, Prov. of Shimotsuke (now Tochigi Pref.), Japan; lectotype deposition, CERK]; 1959: 48 [des. (N), fig. (N)]; Gose 1962: 15 [fig. (N), key (N)]; Tshernova 1962 (in part); Uéno 1973: 523 [fig. (N), key (N)]; Okazaki 1982: 26 [des. (egg. (egg)].

Chitonophora (?) *nigra*: Uéno 1931: 224 [fig. (N)].

Ephemerella sp. (tentatively named "nay") (in part): Imanishi 1940: 206 [des. (N), key (N)].

Cincticostella (*Cincticostella*) *nigra*: Allen 1980: 82.

Ephemerella (*Cincticostella*) *nigra*: Gose 1980a: 288 [fig. (N), key (N)]; 1980b: 368 [fig. (M), key (M)]; 1985: 26 [fig. (N), key (N)].

Cincticostella nigra: Ishiwata 1987: 29; Yamasaki 1987: 115; Ishiwata 1989: 44; Hatta and Ishiwata 1990: 169 [fig. (N)]; Ishiwata *et al.* 1991: 25; Tiunova 1995: 6; Ishiwata and Inada 1996: 38 [fig. (N)]; Ishiwata 1997a: 293; 1997b: 13; Bae 1997: 409; Ishiwata 2000: 73; 2001a: 60; 2002: 7 [fig. (M)].

Description. *Male Imago*. Length (N=27): Body 8.6–9.0 mm; fore wing 9.9–11.2 mm; hindwing 2.4–2.6 mm; caudal filaments 9.9–11.9 mm.

Head: Color chocolate brown; upper part of compound eye of live specimen light brown, lower part black.

Thorax: Pronotum chocolate brown. Basisternum of prosternum (Fig. 29) chocolate brown, with separated longitudinal carinae; carinae slightly converging subapically (maximum width between lateral margins of carina less than twice minimum width); furcasternum chocolate brown; membranous area brown to black. Mesonotum (Figs 19, 25) chocolate brown; lateroparapsidal sutures (LPs) not terminating at MPs; scutellum with posterior prolongation, and pair of membranous posterior lamellae. Mesosternum (Fig. 26) chocolate brown; basisternum rectangular; furcasternal protuberances parallel or somewhat converging posteriorly; membranous area brown to black. Fore wings hyaline; stigmatic area opaque; primary longitudinal veins yellowish brown basally, hyaline apically; intercalary and crossvein pale. Fore legs dark brown to black, often light brown basally; fore tibiae about twice as long as fore femora, dark brown to black; fore tarsi ranked 2=3, 4, 5, and 1 in order of length, often light brown to white; middle and hind legs dark yellowish brown; femora often light brown basally; tarsi often light brown.

Abdomen: Terga dark brown to black, often with clear median stripe. Penes not expanded, pointed at apex and with subapical swelling (Fig. 10); second segment of genital forceps sharply angled inward, with subapical constriction; third segment less than twice as long as broad. Caudal filaments dark brown basally, whitish apically, with brown annulations; terminal filament somewhat longer than cerci.

Female Imago. Length (N=17): Body 7.4–9.6 mm; fore wing 10.1–12.2 mm; hindwing 2.1–3.2 mm; caudal filaments 9.2–10.8 mm.

Other features as in male imago except for usual sexual differences and the following characters:

Thorax: Width of prosternal carinae somewhat greater than in male imago. Mesobasisternum nearly quadrate; furcasternal protuberances wider than those of male, sometimes widened posteriorly. Fore tibiae 1.2–1.3 times as long as fore femora.

Abdomen: Apex of sternum 9 truncate, often with shallowly rounded median emargination.

Male subimago. As in male imago except for duller general coloration and following characters:

Head: Color black uniformly; upper part of compound eye of live specimen chocolate brown, lower part black.

Thorax: Pronotum black, with sometimes indistinct membranous tubercle posteriorly. Mesonotum (Fig. 23) light brown to blackish brown, with membranous

tubercle at junction of mesonotal suture (MNs); pigmented areas chocolate brown; pigmented sclerotization on medioparapsidal sutures (MPs) elongate (length of sclerotization 1/4–1/3 as long as MPs); scutellum with long posterior prolongation and pair of membranous posterior lamellae. Legs black; whole femora and tibiae dark brown to black; tarsi light brown. Wings (Fig. 9) black; intercalary and crossvein not infuscated.

Abdomen: Terga dark brown. Caudal filaments subequal to or somewhat shorter than body length, dark brown basally, light brown apically.

Female subimago. As in male subimago except for usual sexual differences and following characters:

Head: Color black, vertex sometimes with whitish or yellowish marking.

Thorax: Width of prosternal carinae somewhat greater than in male. Width of mesobasisternum subequal to length; furcasternal protuberances parallel, wider than those of male.

Abdomen: Apex of sternum 9 truncate, often with shallowly rounded median emargination.

Mature nymph. Length (N=51): Body 7.3–9.9 mm; caudal filaments 4.6–6.6 mm.

Coloration: General color dark brown to black, often each with clear median stripe on head, thorax, and abdomen.

Head: Without tubercles; genae rounded. Labrum (Fig. 31) with broad, shallow anteromedian emargination. Mandibles (Figs 34, 35) with lateral margin weakly rounded; incisors of right mandible narrow; molar surface of left mandible more-or-less parallel to outer margin of mandible. Hypopharynx (Fig. 33) with rounded lingua; superlingua with row of hairs along anterior margin. Maxillae (Fig. 41) not widened apically, without apical canine, with apical tuft of setae, and with cuticular tooth on medio-anterior edge of galea-lacinia; this tooth long, more than 2/3 as long as crown; maxillary palpi moderately developed, more than 3/4 as long as galea-lacina. Labium (Fig. 44) with rounded glossae, lacking apical projection; paraglossae rounded; submentum rounded laterally.

Thorax: Thoracic nota lacking tubercles. Prosternum with separated longitudinal carinae; carinae slightly converging subapically. Dorsal surface of femora smooth, without clavate setae (Fig. 48); fore femora (Fig. 52a) with subapical band of transverse spines and with spines along outer margin; middle and hind femora (Fig. 52b) with spines along outer margin, ventral margin lacking spines; tarsal claws with 5–8 denticles.

Abdomen: Terga 2–9 with pair of submedian tubercles; these tubercles small, often barely discernible on segments 2–4, well developed on segments 5–9; terga 3–7 with lamellate, imbricated gills. Abdominal sterna dark brown. Caudal filaments more than 2/3 as long as body, dark brown with pale annulation at apex of each segment.

Egg. Length (N=19) with polar cap 161–185 μm, width 110–131 μm. Egg (Figs 11, 12) oval, with polar cap; chorion covered with reticulate tubercles, and with knob-terminated coiled threads (KCT) and micropyles; each reticulation with tubercle, rarely with 2 tubercles near polar cap; micropyle with chorion sperm guide, micropylar channel, micropylar opening, and micropylar rim.

Diagnosis. Although *C.* (*C.*) *nigra* shares many similarities with *C.* (*C.*) *elongatula*, the seasonal distributions of the two species are different, and the color of the wings in subimagoes, body length, and setation of the nymphal femora separate these species (see under *C.* (*C.*) *elongatula*, above). *Cincticostella* (*C.*) *nigra* is compared to *C.* (*C.*) *levanidovae* in the diagnosis given above for *C.* (*C.*) *levanidovae*.

Type material examined. Lectotype and paralectotypes of *Ephemerella nigra* Uéno, 1928: N (alcohol) and 51N (alcohol), respectively, 15-V-1926, T. Kawamura and S. Kitagami.

Other material examined. JAPAN. [Hokkaido] 3N, Satsunai Bridge, Obihiro, 1-VI-1982, RK; 1M, 1N (exuvia), Nakasatsunai, Tottabetsu Riv., Obihiro, 16-VII-1987, SI; 6N, Yabuchi (400 m a.s.l.), Makomanai Riv., Kitahiyama, 10-VI-1990, SI; 2N, Torisaki, Torisaki Riv., Mori, 11-VI-1990, SI; 5N, Zentana, Kikonai Riv., Kaminokuni, 11-VI-1990, SI; 1N, Chitose Riv., Chitose, 16-VII-1987, NK; 19N, Yanbetsu Riv., Abashiri, 5-VI-1985, TI; 10N, Rausu Riv., Rausu, 6-VII-1985, SI; 2N, Shiribeshitoshibetsu Riv., Kuromatsunai, 9-VI-1990, SI; 4N, Tomiwa, Teshio Riv., Nakagawa, 9-VII-1985, SI; 2N, Kuchoro Riv., Shibecha, 3-VI-1991, RK, RK. [Honshu] **Aomori.** 2N, Amida Riv., Yomogita, 13-V-1987, SS; 5N, Asamushi Riv., Aomori, 13-V-1987, SS; 2N, Imabetsu Riv., Imabetsu, 15-V-1987, SS; 1N, Korokoro Riv., Tairadate, 15-V-1987, SS; 5N, Masu Riv., Minmaya, 16-V-1987, SS; 5N, Sanyoshi Riv., Minmaya, 15-V-1987, SS; 2N, Ota, Shiura, 16-V-1987, SS; 2N, Imaizumi Riv., Shiura, 16-V-1987, SS; 2N, Noheji Riv., Noheji, 16-V-1987, SS; 1N, Ikokuma Riv., Kazamaura, 17-V-1987, SS; 4N, Ohata Riv., Ohata, 17-V-1987, SS; 2N, Yunomata Riv., Ohata, 17-V-1987, SS; 3N, Kawauchi Riv., Kawauchi, 18-V-1987, SS; 2N, Nagashita Riv., Mutsu, 18-V-1987, SS; 2N, Wakinosawa, 18-V-1987, SS; **Iwate.** 3N, Kamigou Bridge, Hayase Riv. (370 m a.s.l.), Kamigou, Tono, 21-VI-1993, SI; 9N, Kanaborizawa (750 m a.s.l.), Tono, 21-VI-1993, SI; 3N, Koguroyama, Yahagi Riv. (400 m a.s.l.), Yahagi, Rikuzentakada, 21-VI-1993, SI; **Yamagata.** 2N, Ino Riv., Hisayama, Oguni, 1-VI-1986, TN; **Fukushima.** 6N, Higashiyama Dam, Yu Riv., Aizuwakamatsu, 15-V-1988, SI; 3N, Komadome Pass, Hinoemata Riv., Nango, 15-V-1988, SI; 4N, Shizukawa, Oo Riv., Tajima, 15-V-1988, SI; 4N, Hiyama, Murohara Riv., Namie, 16-V-1988, SI; 13N, Ishimushiro Bridge, Ishimushiro Riv., Kooriyama, 16-V-1988, SI; 7N, Ookuma Bridge, Abukuma Riv., Nishigou, 16-V-1988, SI; 13N, Abukuma Riv., Nishigou, 7-V-1987, TN; 13N, Iwane Bridge, Abukuma Riv., Nishigou, 16-V-1988, SI; 9N, Tazawa, Abukuma Riv., Iwashiro, 16-V-1988, SI; 4N, Yokomuki Hot Spings, Nagase Riv., Inawashiro, 16-V-1988, SI; 17N, Tazawa, Abukuma Riv., Iwashiro, 16-V-1988, SI; 1N, Kitayamamoto, Abukuma Riv., Tanagura, 8-VI-1987, TN; **Ibaraki.** 3N, Kuji Riv., Daido, 8-VI-1987, SI; **Tochigi.** 1N, Higashiarakawa, Kinu Riv., Yaita, 14-V-1988, SI; 5N, Shimozakai, Togeishi Riv., Karasuyama, 16-V-1986, SI; 20N, Ryuzu Water Falls, Yu Riv., Nikko, 27-V-1986, SI; 1N, Yu Riv., Nikko, 14-V-1988, SI; 18N, Yu Water Falls, Yu Riv., Nikko, 27-V-1986, SI; 2F, 23N, Jigokuzawa, Yu Riv., Nikko, 27-V-1986, SI; 1N, Urami Water Falls, Nikko, 6-VI-1987, TN; 1N, Shionoyu, Shiobara, 8-VI-1981, H. Maruyama leg.; **Gunma.** 1N, Kitakaruizawa, Naganohara, 23-VII-1988, SI; 1N, Shira Riv. (1000 m a.s.l.), Fujimi, 28-II-1994, SI; **Saitama.** 1N, Hitomi, Naguri Riv. (470 m a.s.l.), Naguri, 22-IV-1994, SS; 4N, Ichinose Bridge, Koseto, Iruma Riv., Hannou, 22-IV-1994, SI; **Tokyo.** 2N, Youzawa Riv., Itsukaichi, 13-IV-1986, TN; **Kanagawa.** 1N, Hayato Riv., Tsukui, 23-VI-1988, SI; 3N, Shiraishizawa, Yamakita, 8-VII-1983, TN; 24M, 21F, *ibid.*, collected 26-VI-1984, emerged 28-VI/13-VIII-1984, by S. Ishiwata; **Niigata.** 4N, Arasawa Riv., Arakawa, 1-VI-1986, TN; 2N, Kowada, Onna Riv., Arakawa, 1-VI-1986, TN; 2N, Nakazato, Daigenta Riv., Yuzawa, 13-V-1989, SI; 3N, Ueno (300 m a.s.l.), Asahi, 19-VI-1993, SI; 12N, Miomote Riv., Asahi, 2-VI-1986, TN; 1N, Kuromata Riv., Irihirose, 30-VI-1993, SI; 7N, Kuji Riv., Ryotsu, Sado Is., 31-III-

1991, HM; 1N, Umezu Riv., Ryotsu, Sado I-III-1991, HM; **Toyama.** 2N, Shimosourei, Kuro Riv., Ohyama, 10-VI-1989, S. Ta leg.; **Ishikawa.** 1N, Dainichizawa Riv., 7-VI-1980, TN; **Fukui.** 2N, Shirakuri e, Asuwa Riv., Ikeda, 22-III-1993, S. Mochida leg.; **Yamanashi.** 1F, Hondani, ose, Enzan, 2-VII-1987, SI; 1F, *ibid.*, 26-IV-1986, SI; 25N, Kamiashigawa, Ashi (1200 m a.s.l.), Ashigawa, 28-IV-1985, SI; **Nagano.** 3N, Gonbei Pass, Narai Rivkawa, 3-V-1986, SI; 7N, Jizou Pass, Kisofukushima, 3-V-1986, SI; **Shizuoka.** Yushima Bridge, Warashina Riv., Ooma, Shizuoka, 20-IV-1985, SI; 1N, Hizawa (433 m a.s.l.), Inago Riv., Shibakawa, 23-III-1990, T. Kondo leg.; 1N, Hama, Shiba Riv., Shibakawa, 23-III-1990, T. Kondo leg.; 3N, Iriyama, Inago Rhibakawa, 23-III-1990, T. Kondo leg.; 17N, Ookura Riv. (500 m a.s.l.), Shibayamamiide, Fujinomiya, 20-III-1989, SI; 12N, Shiraito Water Falls, Shiba Riv., Sama, Kamiide, Fujinomiya, 20-III-1989, SI; 3N, Amagi Bridge, Kano Riv., Amgashima, 4-III-1985, SI; 1N, Oonabe, Kawazu Riv., Kawazu, 4-III-1985, SI; 2N, ureaches of Kawazu Riv., Kawazu, 4-III-1985, SI; 25N, Barakizawa (500 m a.s.l.), ashina Riv., Wada, Shizuoka, 20-IV-1985, TN; **Aichi.** 3N, Taguchi, Toyo Riv., ara, 3-V-1995, Y. Shibata leg.; **Mie.** Miyazumakyo, Yokkaichi, 31-V-1987, H. Mieg.; **Shiga.** 1N, Ado Riv., Umenoki, Otsu, 20-IV-1985, SI; 8N, Kamihashi, Sako, Otsu, 20-IV-1985, SI; **Kyoto.** 4N, Azodani, Kifune Riv., 19-V-1988, YT; 4N, nara, Kurama Riv., Shizuichi-ichihara, 20-IV-1985, SI; 4N, Kifuneguchi, Kifiv., Kurama-kifune, 21-V-1977, YT; 2N, *ibid.*, 29-V-1977, YT; 8N, *ibid.*, 5-V-1982, 1N, Yuyagadanideai, Kifune Riv., Kurama-kifune, 27-V-1987, YT; **Hyogo.** 1Nama Riv., Ohya, 29/30-XI-1991, YT and K. Tanida leg.; **Nara.** 2N, Chaya Br Yoshino Riv., Tenkawa, 19-V-1992, HM; 1N, Miterai Valley, Kawakami Riv., kawa, 19-V-1992, HM; 4N, Yoshinoyama, Seko Riv., Yoshino, 3-V-1982, NK; **To.** 1N, Sou, Hino Riv., Mizokuchi, 17-II-1980, S. Tanaka leg.; **Shimane.** 9N, Hi Riv., Hikimi, 19-III-1989, SI; 4N, Iwamiyokota, Hikimi Riv., Masuda, 19-III SI; **Okayama.** 1N, Kuroki, Kamo Riv., Kamo, 25-III-1990, I. Yoshitaka leg.; Hirusen Plateau, Asahi Riv., 25-IV-1988, NK; 8N, Kudani, Ukai Riv., Mitsu, 2?1, SI; 3N, *ibid.*, 28-VI-1988, NK; 3N, Ukaikei, Ukai Riv., Mitsu, 27-II-1991, SI; 2achi, Niimi, 29-IV-1990, I. Yoshitaka leg.; **Hiroshima.** 5N, Yusaka Riv., Karugakita-ku, Hiroshima, 16-IV-1987, K. Kamei leg.; 1N, Yusaka Riv., Hiroshima, 1987, K. Kamei leg.; **Yamaguchi.** 6N, Awano Riv., Otsu, 20-III-1989, SI; 2N, Hotoks, Yunoki, Saba Riv., Tokuji, 20-III-1989, SI; 1N, Ikuno Riv., Ato, 20-III-1989, SI Shijuhasse Riv., Ogoori, 20-III-1989, SI. [Kyushu] **Fukuoka.** 7N, Kose Riv., Tnimaru, 13-V-1986, TN; 4N, Ochiai, Kose Riv., Ukiha, 13-V-1986, TN; 2N, Mt. Notori Riv., Amagi, 21-III-1989, SI; 2N, Senzu, Notori Riv., Amagi, 21-III-1989, N, Ikeda, Homan Riv., Chikushino, 21-IV-1988, TN; 13N, Ino Riv., Hisayama, oka, 24-III-1988, SI; 1N, Shojidake Bridge, Hikosan Riv. (450 m a.s.l.), Soeda, -1996, KH; 1N, Hatakekannon, Kuro Riv. (260 m a.s.l.), Kitakyushu, 4-V-1996, **Kumamoto.** 7N, Hi Riv., Izumi, 12-V-1986, TN; 1N, Kuriki Riv., Izumi, 12-V-1986 10N, Ohara Riv., Izumi, 23-III-1988, Y. Oda leg.; 4N, Shakain Riv., Chuo, 12-V-TN; 1M, Hounokibaru, Kuma Riv., Mizukami, 25-III-1989, SI; **Oita.** 1N, Shin amaguni Riv. (320 m a.s.l.), Yamakuni, 21-III-1989, SI; 10N, Todoro Riv., Ya, 21-III-1989, SI; 1N, Onigase, Oita Riv., Hazama, 21-III-1989, SI; 11N, Yunohiita Riv., Shonai, 21-III-1989, SI; 4N, Mt. Kuju, Nogami Riv. (590 m a.s.l.), Koko26-V-1983, K. Ishizuka leg.; 10N, Mt. Kuju, Nogami Riv. (680 m a.s.l.), Kokonoe, 1983, K. Ishizuka leg.; 1N, Shingai, Yamaguni Riv. (320 m a.s.l.), Yamaguni, 6-6, KH; 1N, Aishi Bridge, Yamaguni

Riv. (430 m a.s.l.), Yamaguni, 6-V-1996, KH; 2N, Tochigi, Yamaguni Riv. (100 m a.s.l.), Yabakei, 6-V-1996, KH; **Miyazaki.** 2M, Seiryu Bridge, Kiyokaki Riv., Kiyotake, 23-III-1988, SI; 1M, 1MS, 12F, 3FS, Takemoto Valley, Hitotsuse Riv., Nishimera, 24-III-1989, SI; 12N, Shimogoushigi, Nanatsuyama Riv., Morotsuka, 25-III-1988, SI. **RUSSIA.** [Kunashir Is.] 7N, Sernovodsk Village, Tyurino Riv., 25-V-1976, T. Vshivkova leg.

Discussion. I examined syntypes of this species deposited at CERK. All specimens in a vial labeled *Ephemerella nigra* by Uéno are poorly preserved, being dried, damaged, and mixed with a nymph of *C.* (*C.*) *orientalis*. Since no holotype was designated by Uéno, I here designate the best of the specimens as the lectotype to make clear the specific concept of *E. nigra*. The collection date published by Uéno (1928) is May 5, 1926, but the specimen labeled reads as May 15, 1926.

I found that all specimens identified as *E. nigra* by Imanishi in CERK were misidentified (see Discussion for *C.* (*C.*) *elongatula* above). Besides, his "*Ephemerella* nay" from Japan should be attributed to *C.* (*C.*) *nigra*. Imanishi (1940) noted that Japanese "*Ephemerella* nay" was usually smaller in size and emerged later than *C.* (*C.*) *elongatula* (as *E. nigra sensu* Imanishi 1937). The adults of *C.* (*C.*) *nigra* emerge later than those of *C.* (*C.*) *elongatula* (see Biology), which also tends to confirm the fact of Imanishi's misidentification.

Distribution. The geographical range of *C.* (*C.*) *nigra* covers all of Japan except Okinawa, Amami-oshima Island, and Tsushima Island, and also includes Kunashir Island (Fig. 54b).

Biology. In Kanagawa Prefecture, *C.* (*C.*) *nigra* is restricted to mountain streams (Ishiwata 2000). The nymphs of *C.* (*C.*) *nigra* are rather common in rapid waters of 2nd- and 3rd-order streams. Although they inhabit very diverse types of bottom, they are most commonly found among rocks, gravel, debris, and dead leaves, as is *C.* (*C.*) *elongatula*. The life cycle of *C.* (*C.*) *nigra* is clearly univoltine, and all adults emerge from mid-May to June (Fig. 56). Appearance of very young nymphs in December suggests that diapause occurs in the egg stage during the warmer months.

Cincticostella (*Cincticostella*) *orientalis* (Tshernova, 1952)

[Japanese name: Cherunoba-madara-kagerou]

(Figs 13–16, 20, 24, 30, 32, 36, 38, 42, 45, 49, 53a, b, 55)

Ephemerella sp. (tentatively named "nax"): Imanishi 1940: 205 [des. (N), fig. (N), key (N)]. [N, Korea (4-VI-1936, T. Kawamura, Kangwon Prov.; 6-VI-1936, T. Kawamura, Hamgyongnam Prov.; 14-VI-1936, T. Kawamura, Hamgyongbuk Prov.; 9-V-1937, M. Yamada, Kyonggi Prov.), not located in CERK, probably lost]; Tshernova 1952: 274; Gose 1962: 15 [fig (N), key (N)].

Ephemerella orientalis Tshernova, 1952: 279 [des. (M), fig. (M), key (M)]. [Lectotype M, designated by Kluge (1995); type locality, Sudzukhinsky Reserve, tributary of Ussuri Riv., Russia; lectotype deposition, ZIS]; Tshernova 1958: 74; Levanidova 1968: 271; Bajkova 1972: 192 [des. (MS, FS), fig. (MS, FS)].

Ephemerella tshernovae Bajkova, 1962: 202 [des. (N), fig. (N), key (N)]. [Holotype N; type locality, Khor Riv., tributary of Ussuri Riv., Russia; holotype deposition, ZIS]; Levanidova 1968: 266 [N]; Tshernova 1972: 614; Okazaki 1981: 19 [des. (egg),

fig. (egg)]; Tshernova *et al.* 1986: 137 [fig. (M), key (M)]; Yoon and Bae 1988a: 170 [des. (M, N), fig. (M, N), key (N)]. **Syn. nov.**

Ephemerella (*Cincticostella*) *imanishii* Allen, 1971: 517 [des. (N)], described as new species based on Imanishi's (1940) "*Ephemerella* nax". [Holotype N, see *Ephemerella* sp. (tentatively named "nax") above]. [Synonymized by Tshernova 1972]

Ephemerella imanishii: Tshernova 1972: 614.

Ephemerella (*Cincticostella*) *tshernovae*: Bajkova 1979: 16; Gose 1980a: 288 [fig. (N), key (N)]; 1980b: 368 [fig. (M), key (M)]; 1985: 26 [fig. (N), key (N)]; Kluge 1997: 211 [key (N)].

Ephemerella (*Cincticostella*) *orientalis*: Bajkova 1979: 16.

Cincticostella orientalis: Ishiwata 1987: 29.

Cincticostella tshernovae: Tiunova 1984: 49; Tiunova and Belov 1984: 75 [des. (M, MS), fig. (M)]; Ishiwata 1987: 29 [fig. (N)]; Yamasaki 1987: 115; Yoon and Bae 1988a: 30 [des. (M, N), fig. (M, N), key (N)]; 1988b: 173 [des. (M, N), fig. (M, N), key (N)]; Hatta and Ishiwata 1990: 167 [fig. (N)]; Bae *et al.* 1994: 35; Ishiwata 1997a: 293; 1997b: 13; Bae 1997: 409; Yoon and Bae 1997: 45; Bae *et al.* 2000: 394; Ishiwata 2001a: 60; 2002: 8 [fig. (M, N)].

Description. *Male imago*. Length (N=8): Body 10.6–14.0 mm; forewing 10.6–13.2 mm; hindwing 2.4–3.0 mm; caudal filaments 10.6–12.0 mm.

Head: Color black; upper part of compound eye of live specimen reddish brown, lower part black.

Thorax: Pronotum black. Basisternum of prosternum blackish brown, with separated longitudinal carinae; carinae strongly converging subapically (maximum width between lateral margins of carina more than 3 times minimum width) (Fig. 30); furcasternum blackish brown; membranous area dark brown to black. Mesonotum (Fig. 20) blackish brown; lateroparapsidal sutures (LPs) not terminating at MPs; scutellum lacking posterior prolongation and pair of membranous posterior lamellae. Basisternum of mesosternum black and rectangular; furcasternal protuberances parallel or somewhat converging posteriorly; membranous area dark brown to black. Wings hyaline; stigmatic area opaque; primary longitudinal veins yellowish basally, hyaline apically; intercalary and crossvein hyaline. Fore legs yellowish brown to white; fore tibiae about 1.5 times as long as fore femora; fore tarsi ranked 2=3, 4, 5, and 1 in order of length; middle and hind legs yellowish brown to white; tarsi often dark brown.

Abdomen: Terga black. Penes smoothly tapered apically (not expanded) (Fig. 14); second segment of genital forceps sharply angled inward and with subapical constriction; third segment less than twice as long as broad. Caudal filaments subequal to or somewhat shorter than body length, brown, often dark brown basally and whitish apically; terminal filament somewhat longer than cerci.

Female imago. Length (N=14): Body 7.3–11.5 mm; fore wing 12.5–17.7 mm; hindwing 2.9–4.4 mm; caudal filaments 9.9–11.4 mm.

Other features as in male imago except for usual sexual differences and following characters:

Head: Color black.

Thorax: Scutellum with short, sometimes indistinct posterior prolongation but lacking pair of membranous posterior lamellae. Width between prosternal carinae somewhat greater than in male imago. Width of mesobasisternum greater than length; furcasternal protuberances wider than those of male. Fore legs dark brown to light brown; fore femora paler basally; fore tibiae about 1.1 times as long as fore femora; middle and hind legs yellowish brown; middle and hind femora paler.

Abdomen: Terga dark brown to black. Apex of sternum 9 rounded.

Male subimago. As in male imago except for black general coloration and following characters:

Head: Color black; upper part of compound eye of live specimen reddish brown, lower part black.

Thorax: Pronotum black, with membranous posterior tubercle. Mesonotum blackish brown, with no membranous tubercle at junction of mesonotal suture (MNs); pigmented sclerotization on medioparapsidal sutures (MPs) not elongate (length of sclerotization less than 1/5 that of MPs), sometimes indistinct; scutellum with long posterior prolongation but lacking pair of membranous posterior lamellae. Legs yellow to white. Wings black (Fig. 13); intercalary and crossvein not infuscated.

Abdomen: Abdominal terga black. Caudal filaments shorter than body, dark brown.

Female subimago. As in male subimago except for usual sexual differences and following characters:

Thorax: Width between prosternal carinae somewhat greater than that of male. Width of mesobasisternum subequal to length; furcasternal protuberances parallel, wider than those of male.

Abdomen: Apex of sternum 9 rounded.

Mature nymph. Length (N=28): Body 9.8–14.0 mm; caudal filaments 4.1–5.0 mm.

Coloration: General color dark brown to black.

Head: Lacking tubercles; genae rounded. Labrum (Fig. 32) with deep anteromedian emargination. Mandibles (Fig. 36) with outer margin weakly rounded; incisors of left mandible stout, swollen basally; molar surface of left mandible parallel to outer margin of mandible. Hypopharynx similar to that in Fig. 33; lingua rounded; superlingua with row of hairs along anterior margin. Maxillae (Figs 38, 42) widened apically, without apical canine, with apical tuft of setae, and with cuticular tooth on medio-anterior edge of galea-lacinia; this tooth short, less than half as long as crown; maxillary palpi vestigal, less than half as long as galea-lacina. Labium (Fig. 45) with rounded glossae, lacking apical projection; paraglossae rounded; submentum rounded laterally.

Thorax: Thoracic nota lacking tubercles. Prosternum with separated longitudinal carinae; carinae strongly converging subapically. Femora often with longitudinal line; fore femora (Fig. 53a) with subapical transverse band of spines, spines along outer margin, and hair-like spines along inner margin; middle femora with clavate setae basally and spines along outer margin; inner margin lacking spines; hind femora (Fig. 53b) with a few clavate setae (Fig. 49), and with spines along outer margin; inner margin without spines; tarsal claws with 1–2 denticles each.

Abdomen: Terga 3–7 with lamellate, imbricated gills; terga 5–9 with pair of submedian tubercles and distinct postero-lateral projections; these projections poorly developed on tergum 5, well developed on terga 6–9. Abdominal sterna dark brown to black. Caudal filaments dark brown to black, about half as long as body length, with pale annulation at apex of each segment, and lacking long, hair-like

setaapically.

Length (N=21) with polar cap 161–185 μm, width 110–131 μm. Egg (Figs 15, 16) with polar cap; chorion covered with reticulate tubercles, also possessing knohinated coiled threads (KCT) and micropyles; each reticulation with 3–5 tube micropyle with chorion sperm guide, micropylar channel, micropylar operand micropylar rim.

nosis. *Cincticostella* (*C.*) *orientalis* can be distinguished from all other spec this subgenus of *Cincticostella* by the following characters. In the adults, 1) pthat are smoothly tapered apically (not expanded) (Fig. 14), 2) an anteriorlyowed prosternal basisternum (Fig. 30), and 3) a posteriorly rounded sternumthe female imago and subimago. In the mature nymphs, 1) a deep anteromedmargination of the labrum (Fig. 32), 2) the basally stout, swollen incisors of th mandible (Fig. 36), 3) apically widened maxillae (Fig. 42), 4) a short cuticularn on the maxilla (Fig. 38), 5) tarsal claws with 1–2 denticles each (Fig. 53a, b), acaudal filaments less than half as long as the body. In the eggs, 1) each the choreing covered with reticulation, each of which has more than 3 tubercles (Fig.6).

material examined. Lectotype of *Ephemerella orientalis* Tshernova, 1952penis on slide, 18-VI-1948, A. Sharov. Paralectotype of *Ephemerella orientalis*ernova, 1952: M, penis on slide, designated by Kluge, 1995, same date as lectc paralectotype deposition, ZIS. Holotype of *Ephemerella tshernovae* Bajkov2: N (alcohol), 29-III-1951, O. Ya. Bajkova.

r material examined. JAPAN. [Hokkaido] 1N, Yanbetsu Riv., Abashiri, 5-VI TI; 10N, Bifue, Shikotsu Lake, Chitose, 12-X-1987, NK; 3N, Chitose Riv., Chitollection date unknown, NK; 11N, Rankoshi Riv., Chitose, 14-IX-1994, M. Fukag., IC; 1N, Chitose Riv., Chitose, 16-IV-1987, TI; 2N (1 exuvia), Daini-nikyo Brideshio Riv., Asahi, 9-VII-1985, SI; 1N, Makomanai Riv., Sapporo, 22-VIII-1995 1N, Misumai Riv. (189 m a.s.l.), Sapporo, 24-IV-1984, SU; 2M, 2MS, 8SF, lowaches of Misumai Riv., Minami-ku, Sapporo, 15-VI-1998, Yu-ping Zhang leg.;Jozankei, Shirai Riv., Sapporo, 9-VI-1990, SI; 1N, Suzuriyama Bridge, Toyohira, Sapporo, 29-X-1993, KS; 1N, *ibid*, 26-VIII-1993, KS; 3N, Kaihoku, Mioribetsv., Asyoro, 1-V-1983, NK; 11N, Satsunai Bridge, Satsunai Riv., Nakasats 1-VI-1982, NK; 6N, Kamisatsunai, Satsunai Riv., Nakasatsunai, 27-V-1983, RK;Vari Riv., Nanae, 11-II-1983, TI; 1N, Pirikaneppu, Akan Riv., Akan, 11-VII-19852N, Yukan Bridge, Akan Riv., Akan, 1-V-1983, NK; 4N, Shinnobusya Riv., Mas 21-X-1994, TI, IT; 1N, Urikai Riv., Obihiro, 12-V-1982, K. Onoyama leg.; 2N, *ibid*KI-1984, TI; 1N, Shiribeshitoshibetsu Riv., Kuromatsunai, 9-VI-1990, SI; 1N, Echkeppu Riv., Aibetsu, 6-XI-1995, KS; 1N, Sakuraoka Head Water, AsahikawKI-1995, KS; 1N, Hanasaki Bridge, Asahikawa, 7-XI-1995, KS; 1N, Hibu Bridibu, 7-XI-1995, KS; 1N, Hinode Bridge, Eniwa, 20-VI-1993, KS; 4N, Kuchoro Rivpecha, 3-VI-1991, RK, RK. [Honshu] **Aomori.** 1N, Masu Riv., Minmaya, 16-V-1SS; 1N, Oota, Shiura, 16-V-1987, SS; **Akita.** 2N, Magi, Ota, 5-II-1982, K. Aoya leg.;Magi, Ota, 5-I-1983, K. Aoya leg.; **Fukushima.** 1N, Azumayama, MatsukawIX-1983, K. Ishizuka leg.; 1N, Shizukawa, Oo Riv., Tajima, 15-V-1988, SI; 1N, muki Hot Spings, Nagase Riv., Inawashiro, 16-V-1988, SI; **Tochigi.** 1MS, Jigdv., a tributary of Yu Riv., Nikko, 15-VI-1985, SI; 6N, Ryuzu Water Falls, Yu Rivko, 27-V-1986, SI; 1M, 2F, *ibid.*, emerged 18/21-VI-1986 by S. Ishiwata; 15N, Yu Nikko, 26-V-1985, SI; 1N, *ibid.*, 27-V-1986, SI; 2N, *ibid*, 14-V-1988, SI; 1N, Yu

Water Falls, Yu Riv., Nikko, 15-V-1926, T. Kawamura and S. Kitagami leg., CERK; **Gunma.** 9N, Kinonesawa Riv., Minakami, 27-XI-1995, H. Taira leg.; **Tokyo.** 1M, 8F, 3FS, Kitaasa Riv., Kamiange, Kamiongata, collected 5-IV-1985, emerged 4/7-V-1985, by S. Ishiwata; 81N, Kawai, Tama Riv. (210 m a.s.l.), Ome, 22-V-1994, M. Tashiro leg.; 1N, Kitaasa Riv., Kamiongata, Hachioji, 26-IV-1985, SI; **Kanagawa.** 1N, Sanogawa, Sawai Riv., Fujino, 4-V-1984, SI; **Niigata.** 2N, Daigenta Riv., Tsuchitaru, Yuzawa, 19-III-1985, SI; **Yamanashi.** 1N, Taiko Riv., Makioka, 17-IV-1996, H. Taira leg.; **Nagano.** 1N, Goshodaira, Chikuma Riv., Kawakami, 12-IV-1981, SU; 1N, Kuzu Hot Spings, Omachi, 16-X-1996, Y. Marunouchi leg.; 1FS, Kurokawa, Mitsumine Riv., Hase, 24-V-1994, K. Matsumoto leg.; **Gifu.** 5N, Neohigashidani Riv., Neo, 19-X-1995, H. Taira leg.; **Shizuoka.** 6N, Shiraito Water Falls (500 m a.s.l.), Sibayama, Kamiide, Fujinomiya, 28-IV-1985, SI; **Shiga.** 1N, Miyanoko Bridge, Ado Riv., Kutsuki, 20-IV-1985, S. Tanaka leg.; **Hyogo.** 1N, Nakama Riv., Ohya, 29/30-XI-1991, YT and K. Tanida leg.; **Nara.** 4N, Miterai Valley, Kawakami Riv., Tenkawa, 19-V-1992, HM; **Tottori.** 1N, Sou, Hino Riv., Mizokuchi, 17-II-1980, S. Tanaka leg.; **Okayama.** 2N, Adachi, Niimi, 29-IV-1990, I. Yoshitaka leg. **KOREA.** 5N, Kapyong, Kyonggi Prov., 1-V-1994, Y. J. Bae leg.; 1N, Mt. Odaesan, Sanri, Kangwon Prov., 1-VI-1983, SU; 1N, Mt. Odaesan (700 m a.s.l.), Kangwon Prov., 2-VI-1983, SU; 3N, Kangrim Stream at 500 m upstream of Taejongdae, Pugok Riv., Chiaksan National Park, Kangwon Prov., 19-V-2000, SI; 1N, Mt. Chirisan, Kyongsangnam Prov., 30-V-1983, SU. **RUSSIA.** [Primor'ye] 2M, Kedrovaya Riv., Kedrovaya Pad Reserve, 28-VI-1982, T. Tiunova leg.; 1M, 2N (1 exuvia), *ibid.*, 11-IV-1983, T. Tiunova leg.; 1M, 1N (1 exuvia), *ibid.*, 11-VII-1988, T. Tiunova leg.; 1N, *ibid.*, 6-VI-1992, SI; 1N, Saratovka, Ussuri Riv., 29-V-1992, SI.

Discussion. The mature nymphs of this species can be distinguished from those of the other species by the stumpier body, more expansive anterolateral corner of the pronotum, well-developed submedian tubercles on the abdominal terga, and caudal filaments with intersegmental setae (Yoon and Bae 1988b). In immature nymphs, however, these characters are not always reliable and must be used carefully for distinguishing the species. In particular these are unavailable for separating *C.* (*C.*) *orientalis* and *C.* (*C.*) *nigra*.

I have examined the holotype of *Ephemerella tshernovae* and the lectotype and a paralectotype of *E. orientalis*. The reared male imagoes in the present study are indistinguishable from the types of *E. orientalis* (male imagoes). Although the penis-lobe of *E. orientalis* figured by Tshernova (1952, fig. 99) appears to be longer and wider than that of the present illustrated specimen (Fig. 14), this is because the penis-lobe of the lectotype mounted on a glass slide was drawn slightly backward; original description of male genitalia having a straight penis-lobe with an anteromedian emargination corresponds to Fig. 14. On the other hand, nymphal holotype of *E. tshernovae* (collected in the Khor Riv.) agree well with the nymphs of *C.* (*C.*) *orientalis* determined by rearing to the adult in the present study; therefore, *E. tshernovae* is synonymized herein with *Cincticostella* (*C.*) *orientalis*.

Allen (1971) renamed Imanishi's "*Ephemerella* nax" as *Ephemerella* (*Cincticostella*) *imanishii* and designated the specimen used for Imanishi's (1940) illustration (Fig. 17) as the holotype. Tshernova (1972) synonymized it with *E. tshernovae* without explanation. Comparing the holotype of *E. tshernovae* with Imanishi's illustration and description of "*Ephemerella* nax", I confirmed the synonymy of both species, *E. tshernovae* [=*C.* (*C.*) *orientalis*] and *E.* (*C.*) *imanishii*.

Bajkova (1979) synonymized *E. levanidovae* with *E. orientalis* as the first reviser. In contrast, *E. levanidovae* was revived as a valid species with the position of a senior synonym of *E. orientalis* by Tiunova (1984) because most probably of the page priority of the former. Tiunova's action was followed by Tshernova *et al.* (1986), Kluge (1997), and Bae *et al.* (1998, 2000). I do not admit these synonymy, because these two species can be distinguished by the shape of the penes in male imagoes, wing color characters in subimagoes, the shape of mouthparts in nymphs, and the chorion sculpturing in eggs.

It is highly probable that the eggs described by Okazaki (1982, 1984) as *E. orientalis* are those of *C.* (*C.*) *elongatula* or *C.* (*C.*) *nigra* because of the existence of reticulations on the chorion, each with a tubercle.

Distribution. The geographical range of this species extends from Japan, excluding Kyushu, Shikoku, and the western part of Honshu, to Korea and the Russian Far East (Fig. 55).

Biology. In Kanagawa Prefecture, the nymphs of *C.* (*C.*) *orientalis* occur in mountain streams larger than those inhabited by other species of *Cincticostella*. Nymphs of *C.* (*C.*) *orientalis*, *C.* (*C.*) *elongatula*, and *C.* (*C.*) *nigra* often inhabit the same streams; however, I found *C.* (*C.*) *orientalis* to be usually the least abundant among them. Mature nymphs of *C.* (*C.*) *orientalis* were found in May, about a month earlier than those of *C.* (*C.*) *nigra* and about a month later than those of *C.* (*C.*) *elongatula*, showing a typical univoltine life cycle (Ishiwata 1989). In the Amur River, mature nymphs of this species were found in August (Levanidova 1968).

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A New Species of *Holostaspella* (Arachnida: Acari: Macrochelidae) from Kalimantan, Indonesia

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A species of mite of the genus *Holostaspella* (Acari: Macrochelidae), collected from the ventral body surface of dung beetles in East Kalimantan, Indonesia, is described as new to science. This species, *H. katakurai* sp. nov., is similar to *H. mirabilis* Petrova and Taskaeva, 1964, but differs from the latter in the number of preanal setae on ventrianal shield and ornamentation of sternal shield. The present new species provides an exception to the general correlation between phoresy and absence of paranal extensions of the cribrum in the genus.
Key Words: *Holostaspella*, Macrochelidae, mites, phoresy, cribrum, Kalimantan, Indonesia.

Introduction

The genus *Holostaspella* (Acari: Macrochelidae) is nearly cosmopolitan and comprises more than 30 species, three of which have been recorded in Indonesia: *Holostaspella berlesei* Krantz, 1967 from Sumatra, *H. foai* Berlese, 1910 from Java, and *H. moderata* Berlese, 1921 from Sumatra and Java (Berlese 1910, 1920; Krantz 1967; Takaku 2001). In the course of our study on macrochelid mites of Kalimantan, we found yet another species of this genus associated with dung beetles. It is described here as new to science.

The mite specimens were collected from the ventral surface of scarabaeid dung beetles and fixed in 70% ethyl alcohol. Specimens were mounted whole on slides in PVA (polyvinyl alcohol-lactic acid), after clearing in lactic acid.

In the description, all measurements are given as ranges in micrometres (μm). Dorsal chaetotaxy follows Halliday (1987). Other terminology, especially the description of ventral ornamentation, follows Petrova and Taskaeva (1964) and Krantz (1967).

The holotype is deposited in the collection of the Museum Zoologicum Bogoriense (MZB)/Zoology Division, Center for Research in Biology-LIPI, Bogor, Indonesia, and a paratype is deposited in the Zoological Collections of the Graduate School of Science, Hokkaido University, Sapporo, Japan (ZIHU).